APRIL, 1958
No. 229

ASTM Bulletin

Some Tea Party!
61st ANNUAL MEETING
Boston—June 23–27

American Society for Testing Materials

ASTM BULLETIN

APRIL 1958

Number 229

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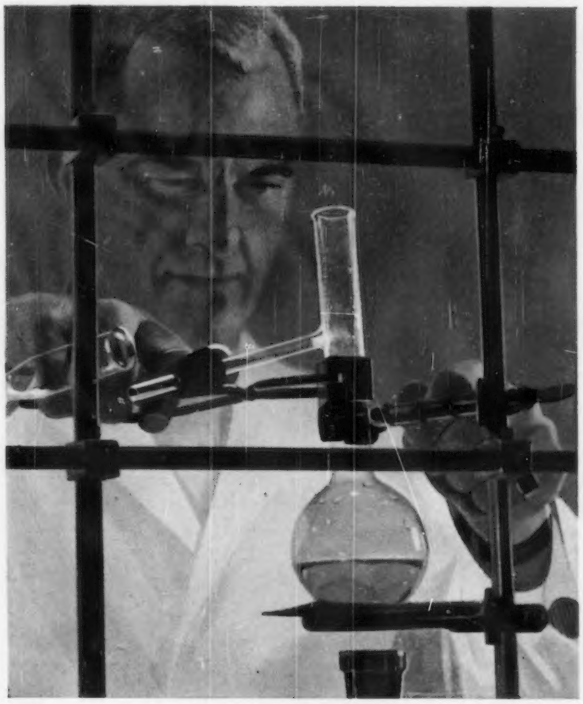

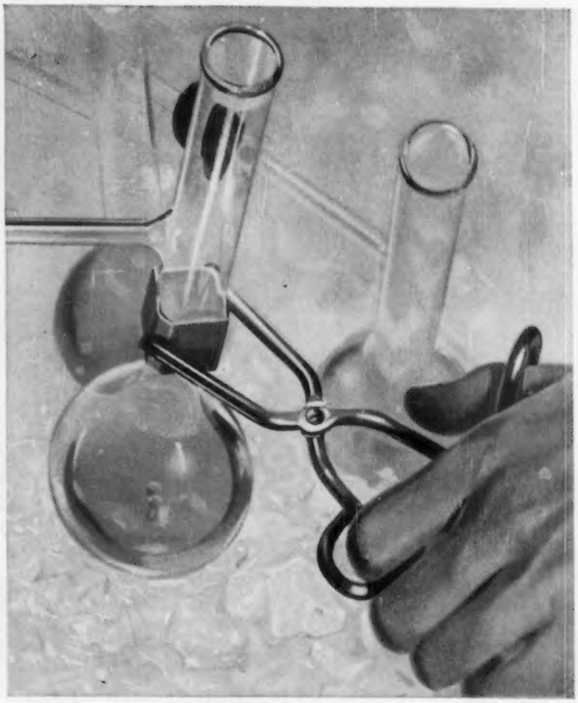

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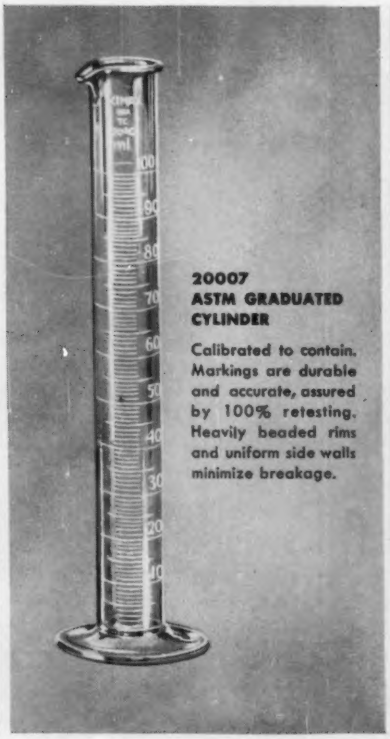

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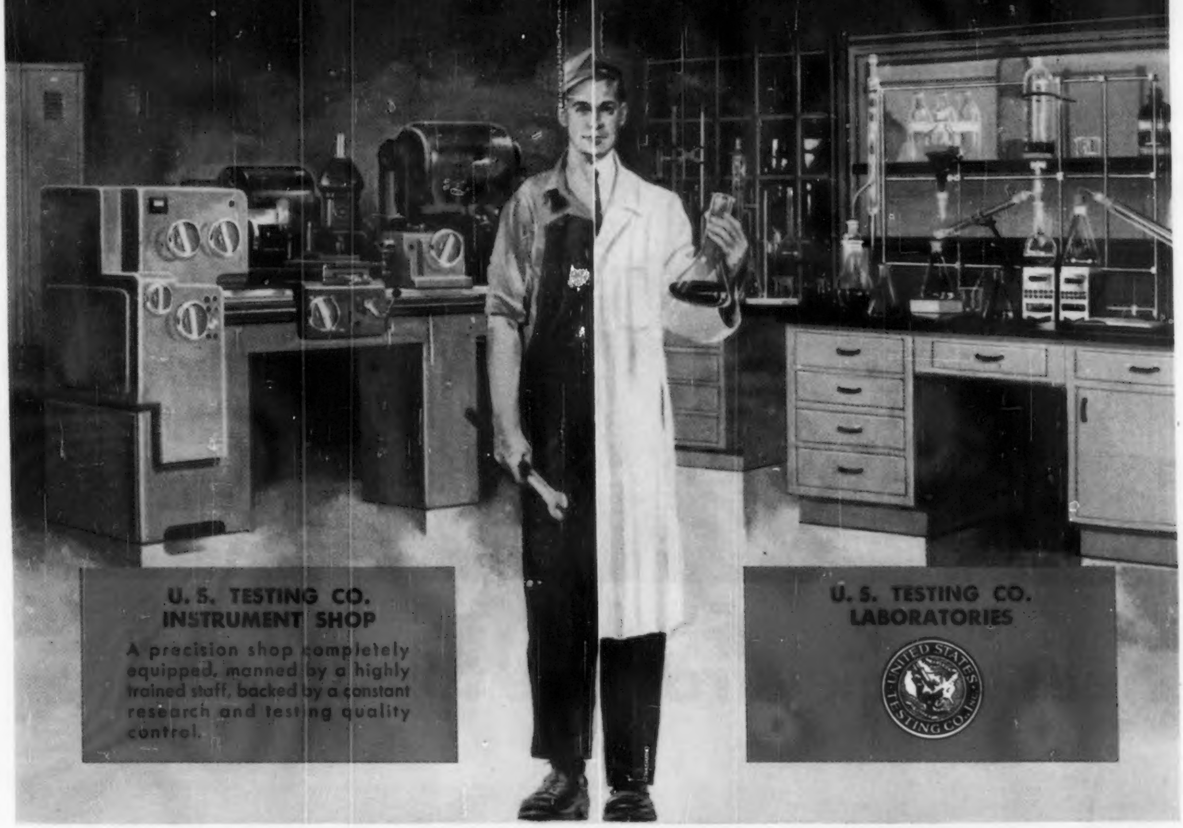

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61st Annual Meeting

Some Tea Party!

Lectures on availability of raw materials and high-temperature metals, four industrial luncheons, apparatus and photographic exhibits, two-score technical sessions, and hundreds of technical committee meetings will constitute the Annual Meeting at Hotel Statler and Sheraton Plaza Hotel, Boston, Mass., June 22–27, 1958.

Technical Program

The Society's 61st Annual Meeting will have the largest number of technical sessions ever scheduled with a total of 40, including eleven symposia. The largest Apparatus Exhibit in the Society's history has made it necessary to secure additional space on the balcony for late applicants. Again the biennial Photographic Exhibit, with a special section on metallography, will add to the interest and educational side of the meeting.

For the first time at Annual Meetings, there will be four industry luncheons, an innovation which proved so successful at the second Pacific Area National Meeting and at the 1958 Committee Week in St. Louis.

Symposia

Eleven symposia are scheduled in the technical program:

Effect of Water on Bituminous Paving Mixtures
Paper and Paper Products—New Developments with Accompanying Requirements for New Testing Methods
Radioactivity in Industrial Water and Industrial Waste Water
Particle Size Measurement
Solvent Extraction in the Analysis of Metals
Some Approaches to Durability in Structures
Fundamentals of Fatigue
Materials Research Frontiers
Applications of Soil Testing in Highway Design and Construction
Radiation Effects on Materials
Bulk Sampling

Headquarters and Cooperating Hotels

The Hotels Statler and Sheraton Plaza are acting as co-headquarters for the ASTM Annual Meeting with the exhibit being held entirely at the Statler. Technical sessions and committee meetings will be held at both hotels, with a few committee meetings at the Bradford Hotel. Sleeping rooms have also been committed by the Bellevue Hotel, Lincolnshire Hotel, Parker House, Hotel Touraine, and University Club.

Technical Sessions

There will be a diversity of technical sessions on the following subjects:

Concrete and Concrete Aggregates
Road and Paving Materials
Textile Materials
Soils for Engineering Purposes
Cement and Concrete
Ferrous Metals
Non-Ferrous Metals
Fatigue
High Temperature
Crack Propagation

Committee Meetings

The detailed list of committee meetings to be held throughout the week will be included in the program given out at the Annual Meeting. An advance tentative outline of these committee meetings was included in the April 4 letter to members transmitting the hotel reservation form. As has been pointed out in the letter, members should consider the committee meeting schedule as tentative, to be superseded by the call of meetings by committee officers; in other words the official notice for committee meetings and subcommittee meetings will be received directly from the secretary of each committee. As we go to press, the following committees plan to meet:

A-1 Steel
A-3 Cast Iron
A-5 Corrosion of Iron and Steel
A-6 Magnetic Properties
A-7 Malleable-Iron Castings
A-10 Iron-Chromium, Iron-Chromium-Nickel and Related Alloys
B-3 Corrosion of Non-Ferrous metals and Alloys
B-4 Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts
B-6 Die-Cast Metals and Alloys
B-7 Light Metals and Alloys
C-1 Cement
C-2 Magnesium Oxychloride and Magnesium Oxysulfate Cements
C-4 Clay Pipe
C-7 Lime
C-9 Concrete and Concrete Aggregates
C-11 Gypsum
C-12 Mortars for Unit Masonry

THE PROVISIONAL PROGRAM. . .

of the 61st Annual Meeting which begins on page 18 is designed to give a comprehensive preview of the symposia, sessions, and special events of the meeting. Brief abstracts are given of the papers to be presented and statements of the scopes of the symposia.

The official program, which registrants will receive at the meeting, will contain full and final details of the sessions, a complete schedule of committee meetings, and the when and where of entertainment features of the week.

C-15 Manufactured Masonry Units
C-17 Asbestos-Cement Products
C-19 Structural Sandwich Constructions
D-1 Paint, Varnish, Lacquer, and Related Products
D-2 Petroleum Products and Lubricants
D-4 Road and Paving Materials
D-5 Coal and Coke
D-6 Paper and Paper Products
D-8 Bituminous Waterproofing and Roofing Materials
D-9 Electrical Insulating Materials
D-11 Rubber and Rubber-Like Materials
D-16 Industrial Aromatic Hydrocarbons and Related Materials
D-17 Naval Stores
D-18 Soils for Engineering Purposes
D-19 Industrial Water
D-20 Plastics
D-25 Casein and Similar Protein Materials
D-26 Halogenated Organic Solvents Organization Meeting
E-1 Methods of Testing
E-2 Emission Spectroscopy
E-3 Chemical Analysis of Metals
E-4 Metallography
E-6 Methods of Testing Building Constructions
E-7 Nondestructive Testing
E-9 Fatigue
E-10 Radioisotopes and Radiation Effects
E-11 Quality Control of Materials
E-12 Appearance
F-1 Materials for Electron Tubes and Semiconductor Devices
Joint Committee on Effect of Temperature on the Properties of Metals

ASTM Conference on Electron Microbeam X-ray Spectro-Analyzer Scheduled

There has been such a general interest aroused in the applications of the new metallography tool that a special session has been scheduled. The conference will review the status of this instrument and its potentialities on Monday evening, June 23, 1958. Subcommittee XI on Electron Microstructure of Metals of ASTM Committee E-4 is acting as sponsor.

Apparatus Exhibit

A description of the Society's 13th biennial Exhibit of Testing and Scientific Apparatus and Laboratory Supplies begins on page 10.

Photographic Exhibit

The 11th ASTM Photographic Exhibit and Competition will provide an interesting and educational diversion from the series of technical and committee meetings. About 100 to 150 outstanding technical photographs are expected. They will be displayed in an area adjacent to the Apparatus Exhibit.

Preprints of Papers and Reports

Each member should have received by now the preprint request blank mailed to all ASTM members on April 11. The First Installment of preprints should go in the mail about May 9, and all papers and reports requested in this first installment will be included in this mailing. A second and third installment of preprints will be mailed on May 28 and June 13, respectively. Those registering at the Annual Meeting will have another opportunity to secure preprints of the various reports and papers. It should be borne in mind, however, that not all reports and papers will be available in time to be preprinted.

For the Better Presentation of Technical Papers

Continuing a plan which is intended to obtain livelier, more stimulating sessions by improving the character of presentations of technical papers, the Administrative Committee on Papers and Publications will again evaluate presentation of papers.

Reporters (not judges) will be chosen by each session chairman and asked to fill out a standard report card for each paper they hear. The check lists include items usually concerned with effective presentation. Copies will be sent, in advance, to each prospective author. During a presentation, the reporter, by check marks and one-word replies will complete a comprehensive, objective statement of what the speaker does, and these statements will be evaluated by the Papers Committee. Any author may obtain his check sheet and learn how his presentation was received.

Ideas for refinement and improvement of the system will be welcomed from anyone; these should be sent to the chairman of the Administrative Committee on Papers and Publications at Headquarters. Volunteer comments on particularly well-presented papers would be especially helpful.

Photographers Attention!

May 17 is the deadline for having your technical photographs entered in the 11th Photographic Exhibit and Competition. Application forms have been mailed to all members and committee members and additional copies are available on request. This is an opportunity to compare your work with others in the same and related industrial and technical photographic fields.

Industry Luncheons

Four Industry Luncheons similar to those which were so successful at the second Pacific Area National Meeting in Los Angeles and the 1958 Committee Week in St. Louis will be held.

Copper and Brass

On Wednesday, June 25, there will be a Copper and Brass Industry Luncheon sponsored by Committees B-2 on Non-Ferrous Metals and Alloys and B-5 on Copper and Copper Alloys, Cast and Wrought. The speaker will be Mr. R. A. Wilkins, Vice-President, Revere Copper and Brass Incorporated, Rome, N. Y.

Road Materials

Also on Wednesday noon will be the Road Materials Industry Luncheon sponsored by Committees C-1 on Cement, C-9 on Concrete and Concrete Aggregates, D-4 on Road and Paving Materials, and D-18 on Soils for Engineering Purposes. Mr. John A. Volpe, the John A. Volpe Construction Co., Malden, Mass., and formerly with the Bureau of Public Roads, will be the speaker.

Petroleum Industry

A Petroleum Industry Luncheon will be held on Thursday noon, sponsored by ASTM Committee D-2 on Petroleum Products and Lubricants. Professor Hoyt C. Hottell, Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, will be the speaker.

Instruments and Apparatus

Also on Thursday noon there will be an Instrument and Apparatus Industry Luncheon sponsored by ASTM Committee E-1 on Methods of Testing at which Dr. A. V. Astin, Director, National Bureau of Standards, will speak.

President's Luncheon

The Society's main function dealing exclusively with ASTM affairs and personalities is the President's Luncheon to be held on Tuesday noon. Featured will be the President's address by retiring President Richard T. Kropf; awards of Honorary Memberships to individuals of widely acknowledged eminence in the fields of work covered by the Society or those who have rendered especially meritorious service to the Society; awards to individuals who have rendered distinguished service to the Society along technical lines; and recognition of 50- and 40-year members.

HORACE W. GILLETT LECTURE

High Temperature Metals—Their Role in the Technological Future by Clyde Williams

THE GILLETT LECTURER . . .

Clyde Williams, President, Clyde Williams and Co., has an international reputation as a metallurgist. He has been closely associated with development of high-temperature metals and worked with Dr. Horace W. Gillett, at both the Bureau of Mines and Battelle Memorial Institute. Dr. Williams joined the Battelle staff in 1929 as assistant to Dr. Gillett, becoming Director in 1934 and President in 1953. He left in 1958 to give his attention to the present firm of which he is head. Dr. Williams graduated from the University of Utah with a B.S. degree in Chemical Engineering and has since been given honorary degrees by that university and by Case Institute of Technology, Michigan College of Mining and Technology, Ohio State University, and Marietta College. His early professional experience was gained in mining and smelting plants in the west, and as a metallurgist for the government of Argentina. He has served as director, trustee, and committee member of many organizations, including the U. S. Chamber of Commerce, National Association of Manufacturers, Atomic Energy Commission, AIME (Past President), Rand Corporation, Howe Sound Co., and Battelle; and is a member of numerous technical societies in this country and abroad.

THE LECTURE . . .

High-temperature metals are important to future technological development for a variety of reasons. Most critical of these are the needs for materials for high-speed aircraft and missiles. Temperature problems in aircraft result from aerodynamic heating and from the nature of propulsion systems. Each level of speed—each type engine—each fuel imposes special, and usually rigorous, materials problems.

Progress is being made in the development and suitable temperature-resistant materials for airframes and skins, and in the development of truly "high-temperature" alloys and cermets for engine components. Cobalt, columbium, chromium, molybdenum, nickel, and tungsten appear to be the metals most likely to serve as the "workhorses" in the high-temperature age of flight and industrial processing. The demand for some of these metals could readily double or triple by 1965. Evidence exists that there are sufficient supplies of the ores of all these metals readily available to the United States to supply these increased amounts.

Whatever the future demand, the Free World will be able to meet its needs through technological development, economic adjustment, and planned programs of stockpiling, substitution, and conservation.

EDGAR MARBURG LECTURE

Man and Raw Materials by Elmer W. Pehrson

THE MARBURG LECTURER . . .

Elmer Walter Pehrson, as Chief of the Division of Foreign Activities of the U. S. Bureau of Mines, directs the Bureau's work related to foreign minerals. Mr. Pehrson is a native of California and was educated at Stanford University, having received an A.B. degree in mining and technology and an E.M. degree in mining and metallurgy. During and following his scholastic training, he was employed as a mining engineer in the West after which he spent a brief period with the Bureau of Internal Revenue. He transferred to the Bureau of Mines in 1928 and specialized in non-ferrous metals until 1935. Within the Bureau Mr. Pehrson has been Chief of the Metal Economics Div., Chief of the Economics and Statistics Branch, and has supervised the Bureau's Mineral Year Book. After World War II he was named Director of the Foreign Minerals Region. He is a member of the AIME (former director), Mining and Metallurgical Society of America, Cosmos Club, Washington Society of Engineers, and the Academy of Political Science, and has been a delegate to several international conferences dealing with metals. His professional work has required extensive world travel, including a 1956 trip, when he circled the globe to observe first hand the Bureau of Mines participation in the Government's foreign aid program and to look into other foreign mineral interests of the Bureau.

THE LECTURE . . .

Expanding raw material supply and the economic progress of mankind go hand in hand. In his quest for the more abundant life man has drawn relentlessly on the mineral, animal, and vegetable kingdoms for constantly increasing quantities of fuels, metals, feedstuffs, and fibers. From them he has fashioned the machines and other accompaniments of advanced modern living. At times supplies of raw materials, particularly the minerals, have been inadequate to meet current needs. In the light of expanding world population and knowledge that mineral deposits are irreplaceable, recurring shortages understandably cause concern over the adequacy of material resources for the future. These anxieties are aggravated by the threat to military security implicit in potential shortages because raw materials are as indispensable in modern warfare as they are in maintaining peacetime prosperity.

The discussion will touch on the major political, economic, and technological factors affecting raw-material availability; the geopolitical implications of raw-material resources and production; and the problems confronting industrial nations in their access to raw-material resources in the backward areas of the world. Consideration will be given to national and international raw-material policies and the industrial and military power inherent in the resource and potential raw-material strength of the Sino-Soviet Bloc, as well as a contrast of the resource limitations on industrial growth in the United States and the U.S.S.R.

Courtesy Convention Bureau, Boston Chamber of Commerce

Boston Ready to Display its Charms for ASTM Visitors

When ASTM members and guests converge on Boston for the 61st Annual Meeting, they will find the host city at the height of its beauty and anxious to dispel any myth of New England aloofness that sometimes—erroneously—is associated with its residents.

The New England District Council, under the guidance of committees that were set up specifically for the purpose of assuring every member, his wife, and his family the most pleasant and profitable meeting he has *ever* attended, has spared neither time nor expense in its efforts. The transportation committee has arranged for special reservation service with the major bus companies, railroads, and airlines, and has collected detailed information on points of interest throughout New England. The hospitality committee, in addition to its normal functions, has arranged a program for the ladies that includes historic tours; visits to Plymouth, Salem, Swampscott and other north and south shore communities; get-acquainted teas; and even baby-sitting service. Those who want to "go it alone," or to stay over for an extended visit in Boston, on the Cape, or "down east" in Maine or Vermont will have many things to choose from—visits to museums, a trip to "Old Ironsides," a walk along historic Freedom Trail, or a tour through the countryside when New England is at its loveliest.

How to Get Around

Members who plan to travel by plane will land at Boston's Logan Airport. This terminal is just across the harbor, one and one-half miles from downtown Boston. The taxi fare to any of the major hotels is nominal—about $2.50—and public buses and airlines limousines also provide good service.

Trains coming in from New York or the west stop first at Back Bay Station, then at South Station. Taxi service from South Station is better, but Back Bay Station is only several blocks from the Statler and very close to the Sheraton Plaza Hotel. Trains arriving from the north terminate at North Station. This terminal is not within easy walking distance to the hotels and it is advisable to use a taxi.

Boston streets have perplexed many a stranger. They twist, turn, and double back and it is easy to get lost. But walking is the best way to see Boston. In the downtown area are such famous landmarks as the Boston Common, the Public Gardens, the Old State House, King's Chapel Burying Grounds, and the Old North Church, all within easy walking distance from the more popular hotels.

City transportation consists of buses and an extensive subway system. The fare is 20 cents regardless of your destination, and to get to the museums, the South Boston waterfront, or the peripherial sections of the city takes only minutes.

Where to Eat

Excellent dining facilities can be found in any of the hotels in the city and in numerous private restaurants. Durgin-Park Restaurant has been in business for over 150 years, serving good food on family style tables. Faneuil Hall Lobster House, the Union Oyster House, and Locke-Obers are world famous, and all are located in downtown Boston. Jacob Wirth's near the Statler Hotel is one of those picturesque restaurants with sawdust on the floor, white-aproned waiters, wonderful German food, and low prices. The Athens Olympia, several doors away has a more modern appearance but has similar quality and prices.

If you are planning to drive, such places as Vaughn Monroe's Meadows, the 1812 House in Framingham, the Tavern in Gloucester, or Hugo Kimballs on Cohasset Harbor are within a half-hour's ride.

ASTM Planned Tours

As special entertainment for the ladies, the New England District has arranged a series of tours about the city and surrounding area.

On Tuesday, June 24, there will be a tour of the city and of famous Concord, Lexington, and Sudbury. Luncheon will be served at the famous restored Wayside Inn. On Wednesday, a tour through the Gardner Museum will be offered. Two others are scheduled for Thursday: one will be to the North Shore, including Salem, and the other to the South Shore, including Plymouth.

A number of companies are planning open house for members and their guests. These include many interesting industrial plants such as the Boston Naval Shipyard, Watertown Arsenal, and laboratories at Harvard University and MIT.

Commercial Tours

For those who miss the planned ASTM tours for some reason, two private concerns, Copley Motor Tours and the Gray Line, operate regular guided tours through Boston and nearby areas in Lexington, Concord, Gloucester, and Cape Cod. Rates range from $2.50 for local trips to $8.00 for the more distant areas. Schedules can be obtained at any of the hotels in Boston.

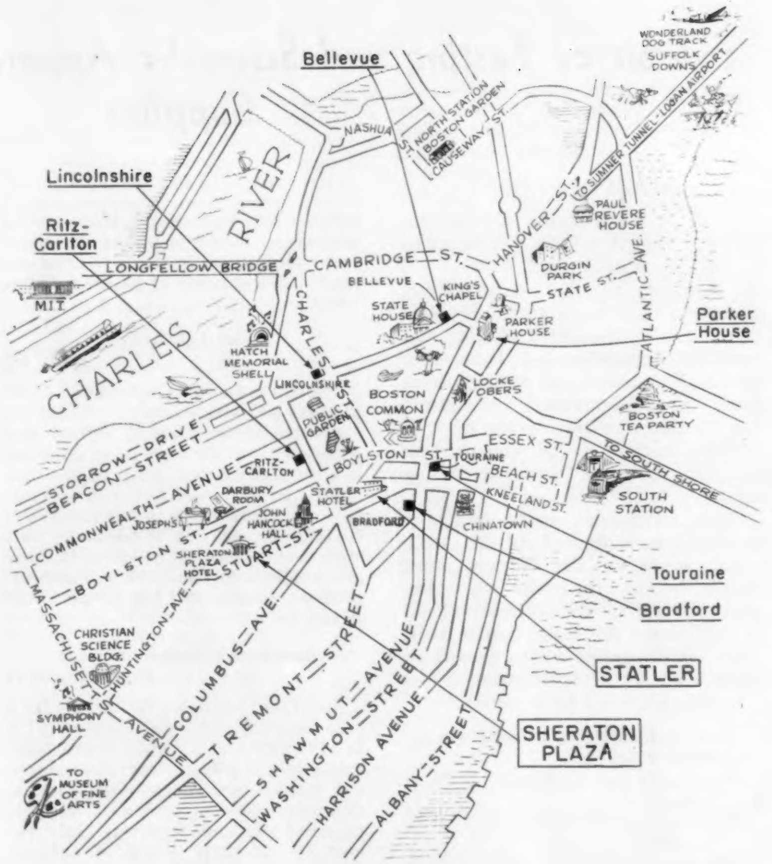
For the Do-It-Yourself Group

Boston is not limited to tours and historical features, as many sports enthusiasts know. The Red Sox will be out of town during the week, but deep sea fishing, swimming, and boating can be enjoyed at any time—but a word to the wise: the South Shore is better for swimming in June than the North Shore because of the water temperature. Sightseeing boats leave for tours of the harbor and of the coastal areas at regular intervals.

Boston's cinemas and legitimate theaters will be offering first run performances during the week of June 22. Other than the summer theaters which are located in the outskirts of the city, all are in or near downtown Boston.

Fifteen museums in or around the city are open daily to visitors. Admission is free, except at the Museum of Science where a fee of 50 cents is charged. An interesting day can be spent in any of these. Those interested in art, natural history, science, flowers, minerals, and other fields will find the exhibits among the finest in the country.

The Massachusetts legislature will be in session during the week and can be visited individually or in groups. Surprisingly, the visit is well worth the time. State police act as guides to explain the procedures and point out



Map of Boston

Showing Cooperating Hotels

many features of the buildings that often are missed by individuals. Sessions start at 2:00 p.m. Monday through Friday.

Although Boston is not known as having an extensive night club area, some good ones do exist. The major hotels offer dancing to good music in pleasant surroundings. Blinstrub's Village offers floor shows, often with nationally known vocalists. Dancing starts at 6:30 p.m. and the shows at 8:30 and 11:00. Prices are nominal. Numerous other establishments along the coast and inland along Route 9 offer similar entertainment.

Sturbridge Village is about an hour and a half drive from Boston, but members who can spare the time should not miss it. This is an authentic and extensive replica of a colonial New England community. The old grist mill, the gun shop, the stocks, the general store, and other houses and shops are fascinating in their authenticity and historical interest.

This Annual Meeting, like all others in the past, is being held primarily for professional reasons. But, being in Boston, it also offers unlimited opportunities for a vacation-business type of trip. The local District has capitalized on this and, being the host, planned many of those little extras that contribute to making this year's meeting a memorable one. So bring your family, relax, and enjoy yourselves in old Bostontown.

Boston Pops

On Wednesday evening, June 25, the New England District Council has reserved the Boston Pops Orchestra for the ASTM annual dinner. This is a must on the schedule. The dinner will be catered by Seilers, famous around Boston for fine food. The orchestra under the direction of Arthur Fiedler will undoubtedly leave you with the feeling that it was the best you've ever heard. Cost for the dinner is $6 per person; the entertainment is free—compliments of the New England District.

Exhibit of Testing and Scientific Apparatus and Laboratory Supplies

INGENIOUS instrumentation and rugged practical applications to ASTM research and testing will be featured by the manufacturers displaying their wares at the Society's 13th biennial Exhibit of Testing and Scientific Apparatus and Laboratory Supplies. A wide range of items, from small, hand-manipulated instruments and electronic control devices through high-temperature ovens and heating elements to giant universal testing machines, will be exhibited.

With all exhibit space originally planned completely sold out and additional space on the balcony being brought into use, the exhibit will be the most successful the Society has ever held. It will occupy the Hotel Statler Ballroom and Ballroom Foyer as well as the Balcony above the Ballroom.

Exhibit hours will be as follows:

Monday, June 23, 12 noon to 6 p.m.; 7:30 to 9:30 p.m.
Tuesday, 11 a.m. to 6 p.m.; 7:30 to 9:30 p.m.
Wednesday, 9 a.m. to 5:30 p.m. (Banquet)
Thursday, 11 a.m. to 6 p.m.; 7:30 to 9:30 p.m.
Friday, June 27, 9 a.m. to 1 p.m. (Closing)

A brief description and pictures of the various kinds of apparatus which will be on display appear on the following pages.

Ace Glass Inc.
Booth 18

Ace Glass will exhibit a number of Mini-Lab items and allied equipment in the new "KIMAX" borosilicate line of glassware. New developments in the Mini-Lab with 14/20 joints; additional items available with standard taper joints and a new line of equipment with spherical 18/9 joints designed to be interchangeable with all present equipment by use of adapters; a complete series of adapters so that Mini-Lab may be integrated with any type of equipment now being used in the laboratory. A new series of Spinning Band Columns based on design patent of the E. I. du Pont de Nemours & Co. The micro size will be shown and will be available after the date of this exhibit.

The Alpha-Molykote Corp.
Booth 31

The Alpha-Molykote Corp. will exhibit two LFW-1 lubricant testing machines suitable for testing a variety of bearing material combinations with liquid or solid lubricants. Machines feature highly accurate loading and friction measuring systems and a number of selective sliding velocities.

Alpine-Lukens Corp.
Booth 105

The Alpine-Lukens Corporation will display the following machines: Alpine Air Jet Sieve, new screening device that screens without vibration in an airstream in a remarkably short time; Alpine Analytical Classifier, for routine analysis of particle size distributions in fine powders in the range between 60 to 15 microns. These analytical devices will be set up in workable condition together with an automatic precision balance to allow proper determination.

American Instrument Co., Inc.
Booths 10 and 11

American Instrument Co. will display a heat distortion tester for plastics (ASTM D 648) with added feature—vicat penetration test for polyethylene; Porosimeter, test for pore size and pore-size distribution by mercury intrusion method within range 0.1 mm to 0.06 microns; Filmeter, used for thickness testing of anodized aluminum (ASTM B 244) and thickness of organic coatings such as paint, varnish, and lacquers on nonmagnetic material (ASTM D 1400); Aminco Humistat, an inexpensive, reliable humidity controller, especially applicable to dynamic dehumidification and humidification; electric hygrometer affording precision humidity measurements at near or remote locations.

H. Reeve Angel & Co. Inc.
Booth 67

H. Reeve Angel & Co. will display WHATMAN and REEVE ANGEL filter products for general research, industrial filtrations, and for use in standard ASTM tests. Also on display will be National Appliance Co. apparatus: Model 5730 revolving shelf oven for use with method of test for loss on heating of oil and asphaltic compounds (D 6); Model 9150 emulsion and demulsibility apparatus; Model 9750 unsulfonated residue of spray oil apparatus; and a vacuum oven for vacuum drying down to one micron.

Atlas Electric Devices Co., Inc.
Booth 68

The Atlas Electric Devices Co. will display its latest model Weather-Ometer used for accelerated weathering tests on paint, rubber, plastics, and other materials. Technical representatives will be on hand to discuss new testing techniques and maintenance.

Atlantex Corp.
Booth 63

The Atlantex Corp. will have on display its X-ray laboratory equipment and microscopes.

Atomic Energy of Canada Ltd.
Booth 5

The Cobalt-60 Irradiator—the GAMMACELL 220-in.—will be one of the features shown in Atomic Energy of Canada Limited's display. Of convenient size, the Gammacell 220 provides dose rates exceeding 1,000,000 r per hour at the center of a 220 cu in. irradiation chamber (6 in. diam by 7$\frac{3}{4}$ in. high). The Cobalt-60 source is arranged in "squirrel cage" configuration and into this cage the irradiation chamber moves by pushbutton control. The chamber is automatically returned from the irradiate position after a preset time. Access tubes to the irradiation chamber facilitate the irradiation of liquids or gases or the use of electrical leads. The floor area required is 16 sq ft. Only in rare instances will any special installation preparations be needed.

Baldwin-Lima-Hamilton Corp.
Booths 33–36

The Baldwin-Lima-Hamilton exhibit will feature the new Mark "G" Servomatic tester. This machine offers complete automatic control of testing functions such as pacing, cycling, and maintaining of load strain and platen position. An exclusive fixed-center test feature offers maximum convenience in testing setup, particularly for environmental studies. On display for the first time will be the new B-L-H Model AH-5 Direct Stress Fatigue Machine. The AH-5 is specifically designed for high-speed axial load testing for both room and elevated temperature fatigue studies. This new unit features full inertia force compensation, high frequency (3600 cpm) and a high degree of alignment accuracy.

Bausch & Lomb Optical Co.
Booth 19

Bausch & Lomb will display a variety of equipment, including Hand, Abbe, and Precision Refractometers; Spectronic 20 spectrophotometer-colorimeter; color analyzer attachment; wide field, laboratory and research microscopes, ballrometer, gratings, and filters.

Branson Instruments, Inc.
Booth 4

Branson Instruments, Inc., will exhibit a complete installation for ultrasonic thickness gaging, recording, and detection of laminar flaws. The 21 by 24 by 68-in.

Model R Vidigage can measure thickness of metals, glass, and plastics between 0.005 and 2.5 in. with micrometer accuracy. Readings are obtained instantly and nondestructively by applying a transducer to one side of the work and noting the thickness indication on the instrument's cathode ray screen and/or recording chart. Several models of Sonogen ultrasonic cleaning installations will also be shown, including the new self-contained Model H-50 cleaner, which are ideal for unattended and quick removal of insoluble soils from precision instruments, and other items which must be scrupulously clean before assembly.

Brinkmann Instruments Inc.
Booths 47 and 48

New equipment not previously demonstrated will be shown. Among these instruments will be a fully automatic recording dilatometer for temperatures from 500 to 1550 C, high-temperature furnaces for operation at 1800 C, the new Zeiss fully automatic camera microscope Ultraphot for transmitted and reflected light, also a line of Ultra thermostats for highly accurate temperature control and the automatic recording vacuum micro balance, Electrona. Also on display will be some other novel weighing devices such as the VDF Micro Torque Balance.

Brookfield Engineering Laboratories, Inc
Booth 53

A Merrill-Brookfield coaxial cylinder high shear viscometer will be exhibited for the first time. Capable of measuring over a continuously variable rate of shear, the Brookfield-Merrill viscometer incorporates automatic recording of shear and stress and a built-in temperature control. It has the ability to operate automatically through a preset, timed cycle. Utilizing a truly unique air bearing, the instrument can be used for the measurement of very low—as well as very high—viscosity materials. Torque measurements are made by a strain gage incorporated in an adjustable linkage system—thus the operating range of the unit may be quickly and easily changed.

Buehler Ltd.
Booths 65 and 66

In keeping with current high requirements for metallography in both research and routine applications, the Buehler exhibit will feature equipment designed for speed, automation, and the reduction of the importance of the human element in the preparation of metallographic samples. In operation will be the Automet polisher, Powermet press, electrolytic polisher, ultrasonic cleaner, and accompanying equipment. The Powermet press is a push button operated unit, self contained, with every convenience for making mounts rapidly. These mounts are placed, six at a time, in the Automet unit which performs the complete grinding and polishing cycle. The new electrolytic polisher has eliminated the uncertainties and difficulties experienced with other units in electropolishing.

Central Scientific Co.
Booth 62

Central Scientific Company will show a wide variety of items: the Cenco moisture humidity apparatus for determining the moisture condition of hardened concrete block; the new Cenco-Indiana smoke point lamp which measures the burning quality of hydrocarbon fuels; Cenco automatic amperometric-coulometric titrator for mercaptans and olefins (ASTM proposed tentative method of test), new Color-®-Matic end point detector; improved Cenco vapor phase analyzer; new micro Lab-Jack accessories, including the Glas-Col heater supports; completely redesigned line of lab hardware; pressure jar for specific gravities of liquefied petroleum; stainless steel immersion heaters; two improved indicators for entrained air in fresh concrete; and other new lab apparatus.

Coleman Instruments Inc.
Booth 71

Coleman Instruments Inc., will display a complete line of spectrophotometers, including three models of the Junior Spectrophotometer and the Universal Spectrophotometer, Nephelometers and Model 12C Photofluorometer; a new line of automatic titrators, including a Photo Sensor Titrator and a completely automatic two position Titrator; a new laboratory pH meter and a redesigned portable model pH meter; and a new automatic buret filler.

Coulter Industrial Sales Co.
Booth 30

The Coulter Counter presents a new approach to size analysis. The instrument is designed to size particles accurately and in three dimensions by means of high-speed electronics, at the rate of several thousands per second. Particles size range covered is from 0.5 to several hundred microns. Applications are virtually unlimited, and include slurries, dusts, powders, and emulsions of all kinds. A suspension of particles in electrolyte flows through a small aperture having an electrode on each side. As each particle passes through, aperture resistance changes in proportion to size, and the resultant series of electrical pulses is amplified, scaled, and counted.

Custom Scientific Instruments, Inc.
Booth 45

The CSI booth will include instruments for testing in the following fields: plastics, rubber, adhesives, textiles, insulation, cement, and calibration. Exhibits will include the Dow Gas Transmission Cell, designed to measure the gas transmission rate of plastic sheeting and plastic coated papers; Compression Set Apparatus consisting of three flat plates between which rubber specimens are compressed; the Climbing Drum Peel Apparatus for determining the comparative peel resistance of adhesive bonds; Cohesion Tester for measuring the dynamic forces involved in the drafting of strands of textile fibers; Alundum Guarded Hot Plate and the Pittsburgh Corning Thermal Conductivity Probe to measure thermal conductivity; the Long Life Sieves for routine hourly quality control testing; the Templin Calibrator is a precision checking instrument for extensometer and strain gages; and the Dial Indicator Calibrator for checking and calibrating of dial indicators.

Doble Engineering Co.
Booth 9

Doble Engineering Company's display will feature various test equipment and methods used in insulation testing and maintenance. Included will be the Doble Oxidation Comparator for evaluating insulating oils. The comparator will be shown both as described in ASTM Suggested Method for the Determination of Sludge Free Life, and also with provisions for continuous electrical monitoring and recording of the progress of the accelerated oxidation tests. Field test equipment for measuring corona and the Doble Water-in-Oil meter will be shown in operation. The latest in the Doble line of power factor test equipment for both solid and liquid insulation will be displayed.

Encyclopaedia Britannica
Booth 25

Encyclopaedia Britannica will display its 1958 edition together with accessories, research report and year book.

Fisher Scientific Co.
Booth 51

A new instrument, the Fisher ASTM Colorimeter designed to the specifications set up in ASTM D 1500 for determining the colors of a variety of petroleum products, will be demonstrated. The new high-temperature Model 300 Fisher-Gulf Partitioner for gas-liquid partition chromatography. Also, one of the complete line of flash point testers, the Fisher/Tag Improved Open Cup Tester, will be on display. In addition to these instruments, Fisher Scientific will demonstrate the latest time- and labor-saving equipment for research and control laboratories.

General Electric Co.
Booth 101

General Electric Co. will display a molecular gage; Zahn viscometer; gage meter; thickness gages and roughness specimens; current limited hi-pot tester; 10-kv winding insulator tester; concentric thermocouple; and hand pyrometer.

General Radio Co.
Booths 40 and 41

The General Radio exhibit will include instruments for the measurement of dielectric constant and dissipation factor of electrical insulating materials over a frequency range extending from 60 cps to 5000 Mc. One outstanding new item is a slotted line for making these measurements in the range from 150 to 5000 Mc. This device measures easily prepared, cylindrical samples and requires no specialized skill to operate it. Nominal accuracy of measurement is 2 per cent for dielectric constant and 5 per cent for dissipation

factor. Very low-loss materials, such as Teflon and polystyrene, can be measured.

The Emil Greiner Co.
Booth 29

The Greiner Co. will display a Saybolt constant temperature viscosimeter bath, electronic deluxe, four-tube model. This instrument may also be used as a two tube unit. The bath can be used with either water or oil as the bath medium because the heating elements are totally encased in stainless steel. The apparatus is constructed with an inner bath container of deep drawn stainless steel and a polished stainless steel outer jacket. The heavy, black, heat resistant cover has openings to support four viscosity tubes. If a two tube model is required, the viscosimeter is provided with screw type sealing plugs to close off two openings in the bottom of the bath container. A compact instrument panel, mounted at the top rear of the bath, is equipped with all controls.

William J. Hacker & Co., Inc.
Booths 27 and 28

Shown in operation will be two automatic electronic tensile testers of advanced design for load measurements from 5 to 20,000 grams. Another "first time" exhibit will be a new torsional damping tester for plastics, rubber, and similar materials and a "De Mattia" type rubber fatigue testing machine of twin column design for simultaneous testing of 16 specimens; also a machine to determine the hardness of foam rubber and the Reichert microhardness tester known for its extreme precision in placing indentation.

Hallikainen Instruments
Booth 64

Hallikainen Instruments will show constant temperature baths for viscosity measurements and general purposes, incorporating Hallikainen-Shell THERMOTROL temperature controller for precise control of the liquid bath temperature; also the original ZEITFUCHS viscometers and regulators now being manufactured by Hallikainen. The exhibit will also include a demonstration of their THERMOGRAF incremental temperature recorder, allowing for full span recorder readings of as low as 0.1 C. New null transmitter for Reid Vapor Pressure readings by sensitive electrical methods.

Frank L. Howard Engineering Co.
Booth 50

Portable concrete core cutting machine widely used throughout the work will be on display. Information will also be available on other core cutting machines and foundation exploration drills.

Instron Engineering Corp.
Booths 60 and 61

The Instron exhibit will focus on the Company's line of universal testing apparatus. These instruments will be completely equipped with accessories for tensile, compressional, and flexural type testing. All apparatus will be operating for actual demonstration. A single unit is capable of testing and recording the stress-strain data of materials with breaking strengths of less than two grams to a maximum of 10,000 lb. In addition, Instron will display high-temperature creep and tensile testing instruments which enable tests to be performed at 2200 F in inert and vacuum or artificial atmospheres.

The Kanthal Corp.
Booth 32

Kanthal Corp. will exhibit Kanthal Super, a new resistance heating material with a maximum recommended element temperature of 1700 C. This is produced through a powder metallurgical process and extruded into standard hairpin element forms and straight lengths. The resistance of Kanthal Super elements is reported not to change with use. Thus, any number of new and used elements may be connected in parallel or in series without the need of matching resistances. Furthermore, high surface loadings provide high heat output and therefore fewer elements are required to obtain maximum chamber temperatures. A complete line of tubular and box type laboratory furnaces equipped with Kanthal Super elements will be featured.

King Tester Corp.
Booth 16

The King Tester Corporation, manufacturers of standard and special Brinell hardness testing equipment, will display their full line of hardness testing equipment. Included will be the standard King portable Brinells that permit Brinell tests to be made anywhere in the plant or out in the field with complete accuracy. Featured also will be the new model tester designed to make hardness tests on the interior walls of cylinders or cylindrical openings within engine blocks, castings, etc. Shown also will be another new model tester designed to make end tests on cylinders, die blocks, etc., hitherto too large for standard testing machines. This tester weighs only 45 lb and can be used in any position.

Laboratory Equipment Corp.
Booth 3

LECO will have an operating exhibit featuring its 5-min oxygen analyzer for steel, tungsten, titanium, and other metals and alloys. In addition, there will be a completely automatic carbon determinator and an electronic weighing balance, both of which are new items.

Leeds & Northrup Co.
Booths 20 and 21

Leeds & Northrup will display laboratory instruments, research recorders, and controllers.

E. Leitz, Inc.
Booth 75

E. Leitz, Inc., will display research microscopes UAM with accessories for reflected and transmitted light; Aristophot photomicrographic apparatus for micro and macro work; bench type metallurgical microscope, Panphot photomicrographic camera with special flat field objectives, including new xenon gas-filled lamp. Also high and low power prism binocular magnifiers.

Lessells and Associates Inc.
Booth 57

Lessells and Associates, Inc., will exhibit an automatic electromagnetic fatigue machine with special features including the elimination of specimen grips, completely automatic operation, and provision for modulating the stress amplitude to preselected programs. Reversed bending fatigue tests have been performed using this machine on a wide range of ferrous materials, non-ferrous metals, plastics, and composite honeycomb structures. Wide latitude is possible in specimen size and shape.

Lindberg Engineering Co.
Booths 23 and 24

The Laboratory Equipment Division and Pilot Plant Equipment Division of Lindberg Engineering Co. will feature a number of new furnaces suitable for vacuum or atmosphere processing on a laboratory or pilot plant scale. Operating temperatures up to 2150 F with vacuum as low as 0.05 micron. A new pilot size ammonia dissociator will also be displayed as well as a new box type furnace, operating at 2000 F, which is ideal for ashing work with petroleum fractions.

Loomis Engineering & Manufacuring Co.
Booth 2

Loomis will display its 20-ton hydraulic press which is built to fill the urgent need for a more satisfactory press to do precise and accurate laboratory production, and testing in many fields. Three sturdy, equally spaced columns minimize bending deflection and accurately guide the moving platen. Set-up time is minimized by the hand wheel adjustment on the moving head to accommodate work requiring a wide variation in opening. This press can be supplied with various accessories, including heating platens, temperature controls, quick air closing, etc.

Macalaster Bicknell Company
Booth 8

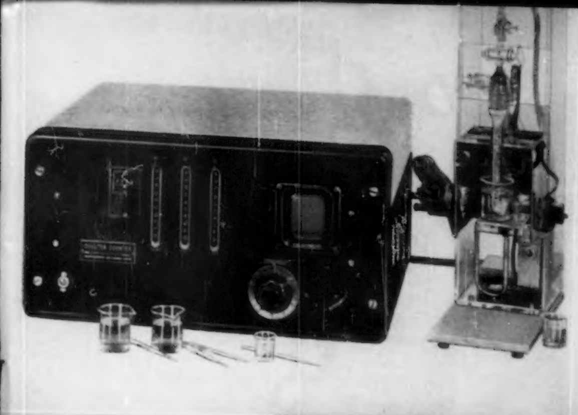
Macalaster Bicknell Co. will display the new "Precision ASTM" colorimete-

First row, left to right: particle-size counter; colorimeter; multirange fatigue tester.

Second row, left to right: multipurpose balance; electromagnetic fatigue machine; gas transmission cell; air-operated soil-testing machine; (below) precision machining device for test specimens.

Third row, left to right: creep tester; cobalt-60 irradiator; hardness tester for interior of cylindrical openings; sieve shaker; foam-rubber tester.

Fourth row, left to right: industrial Airbrassive unit; dielectric measuring line set up with generator and detector; electro-polisher; (below) internal-bond tester.



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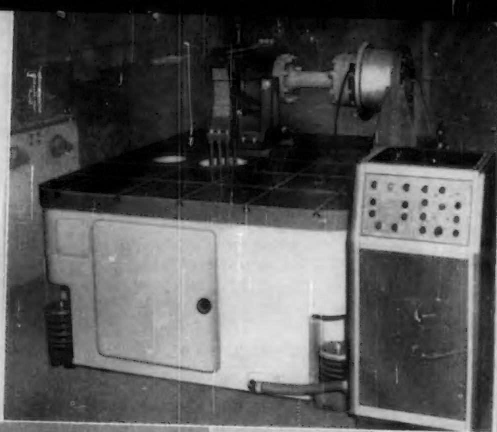


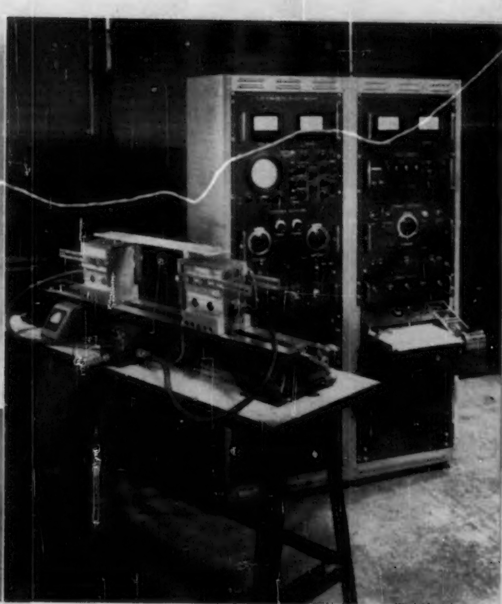
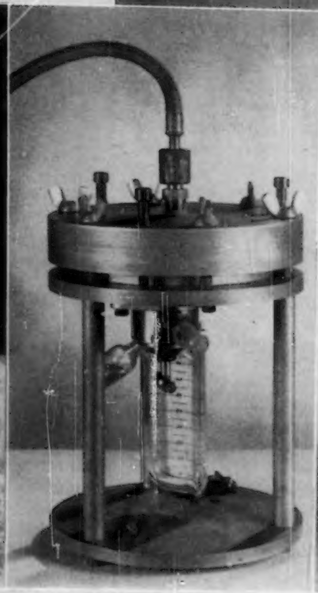
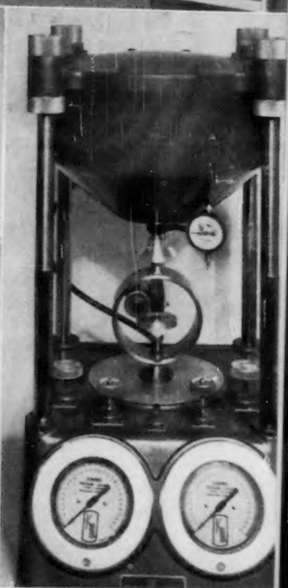

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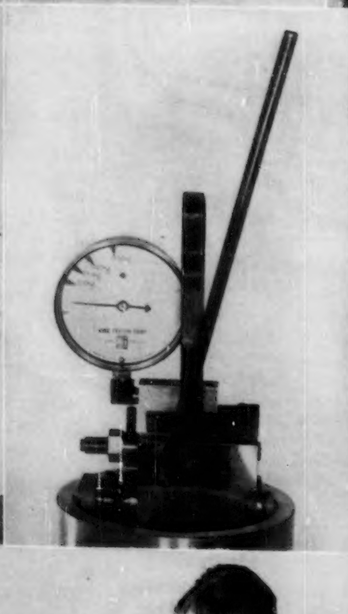
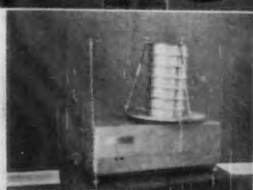
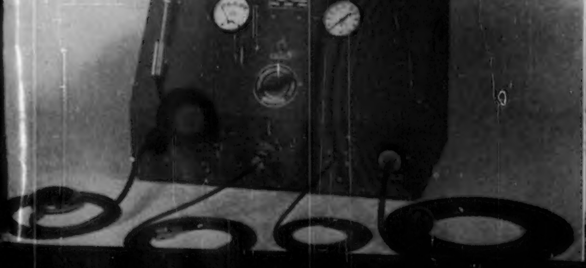






designed to comply with the Method of Test for Measuring Color of Petroleum Products (D 1500), for specifying standards in fundamental terms, and for obtaining substantially improved chromaticity. The colorimeter features simple cleaning and maintenance; continuously cool, comfortable and easy operation; rigid optics alignment; easy viewing; "light tight" extraneous and source light; and stable, small, compact construction.

Metalab Equipment Co.
Booth 58

Metalab furniture and laboratory equipment are designed in sectional units to meet a variety of needs. Basic equipment, plans and designs demonstrating complete installation programs available will be shown. Laboratory equipment and furniture combine beauty, flexibility, utility, and sound construction at a cost compatible with today's budget.

Mettler Instrument Corp.
Booth 59

Mettler Instrument Corp. has added a new Multi-Purpose line to its series of analytical and precision balances. The Multi-Purpose balances are designed for high-speed control work in the 2–0.2 mg accuracy range. The new balances are compact (only 8 by 13 in. space required) as well as fast. A weighing of an unknown takes only 20 sec maximum. Like all other Mettler balances, weighings are made on the substitution principle to insure highest accuracy.

Nuclear-Chicago Corp.
Booth 72

Nuclear-Chicago will exhibit a complete line of radiation detection, counting, and recording instruments. Scalers, rate meters, gamma-ray spectrometer systems, Geiger and scintillation detectors will be shown. Featured will be the new "d/M-Gauge" for rapid determination of moisture content and density of a wide variety of inorganic materials. Catalogs, brochures, and radiochemical price lists will be available at the booth.

Tinius Olsen Testing Machine Co.
Booths 12 and 13

Olsen will exhibit for the first time the Tinius Olsen "X-Y" Electomatic universal testing machine and a new air-operated creep testing machine. Other items that will be exhibited will be an air-operated Brinell hardness testing machine and two new soil testing machines, namely the 355 Conbel testing machine and a hand-operated unconfined compression testing machine.

Philips Electronics, Inc.
Booths 54 and 55

The Norelco Industrial Image Intensifier will keynote the Philips Electronics, Inc., display. It has made possible a new technique in electron fluoroscopy which has extended the range and application of fluoroscopic inspection by permitting daylight examinations, inspection of thicker sections and has rendered brighter, more detailed images of the part. Conjunctively, such equipment as the MG-150 and MG-300, featuring a constant potential source and extremely fine focal spots (essential prerequisites for optimum performances of the electronic fluoroscope), and a complete line of portable equipment will also be displayed.

Picker X-Ray Corp.
Booths 37 and 38

Picker X-Ray Corp. will exhibit the following: Andrex new lightweight (73 lb), 160-kvp X-ray machine, the lightest available at this output; Picker 90-kv portable, ideal for field use and light metals; Androscope stress analyzer, a portable unit using the diffraction principle for the measurement of stresses in tanks, boilers, aircraft structures and the like; Technical Operations Model 490 portable 100 curie iridium unit with remote controls for radiography; and Technical Operations Gammalarm, a radiation detector which rings an alarm at levels of radiation over any preset value.

Plas-Tech Equipment Corp.
Booth 69

Plas-Tech Equipment Corp. will display its Plastechon high-speed testing machine for measuring tensile, flexural, and stress-relaxation properties of materials at loading rates up to 100 lb per millisecond. This corresponds to 100–200 in. per sec depending on the modulus of elasticity of the material being tested. Stress-strain or stress-time data at these high loading rates are obtained via oscilloscope-camera techniques; permitting accurate measurement and recording of properties of materials under conditions of shock loading.

Posey Iron Works, Inc.
Booth 52

The exhibit of the Posey Iron Works will concentrate on the theme of mixing, blending, and process conditioning of presized solids materials. Two laboratory size "Lancaster" countercurrent rapid batch mixers of latest design will be featured, plus a running visual story using color slides, to illustrate the range of batch mixers, ribbon blenders, pug mills and auxiliary apparatus produced by the Brick Machinery & Mixer Division of the firm. One of the laboratory size mixers which will be on display is the "Lancaster" Mixer, Symbol LWD fully self-contained type with muller.

Rainhart Co.
Booth 26

The Rainhart Co. will display testing equipment for soils, concrete, and for miscellaneous use.

Scientific Industries, Inc.
Booth 56

Scientific Industries, Inc., will feature specialized laboratory equipment and transistorized regulated power supplies, especially the Ultra-Buret which combines fine readings down to 0.001 ml for micro titration with high capacity up to 7 ml for macro work. Another feature will be a new transistorized reference supply which uses 115 v a-c input to obtain accurate d-c output of 1 to 6 v, replacing a battery reference standard. A motor-driven timer a small rotator agitator, special clamps and the filter stick assembly for the ASTM method of oil content of petroleum waxes will also be shown.

Scott Testers, Inc.
Booths 6 and 7

Scott Testers, Inc., will exhibit in operation, Model B internal bond tester for splitting paper into two layers edgewise and measuring the force required, particularly applicable to gummed and laminated papers; In operation, STI Mooney viscometer for evaluation of viscosity, scorch, and cure characteristics of elastomers in true conformance with "Mooney Point" designations of ASTM D 927 and D 1077; a model of the metal "Heatbath" for evaluating the aging properties of rubber and plastic compounds at elevated temperatures as required by modern military and industrial applications; and Model J-5 tensile tester with "Accr-O-Meter" electric weighing system providing high accuracy, widely variable speeds of pull and infinite variety of loads from 0.1 to 2000 lb tensile.

Service Diamond Tool Co.
Booth 22

Service Diamond Tool Co. will display its line of hardness testers, including standard Rockwell testers, superficial testers, motorized units, microhardness testers, and portable hardness testers. Accessories will also be shown.

Sieburg Industries, Inc.
Booth 46

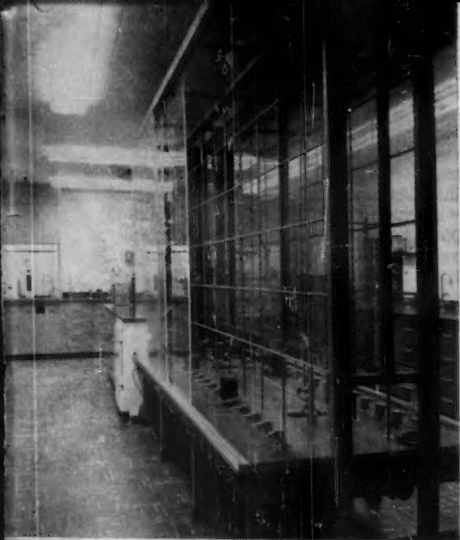
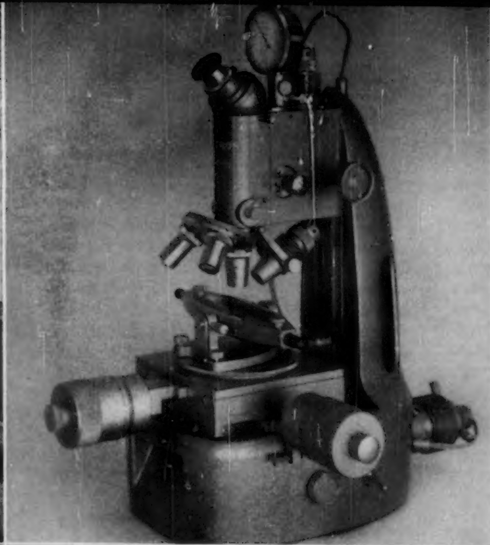
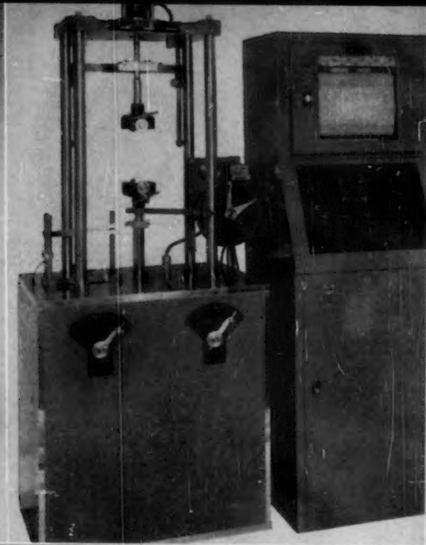
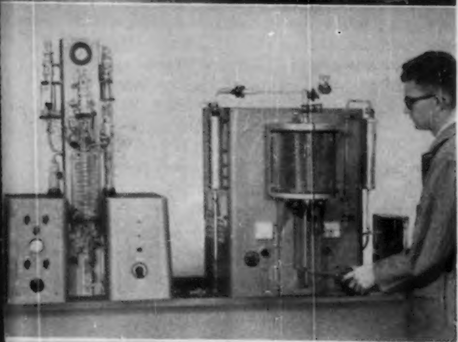
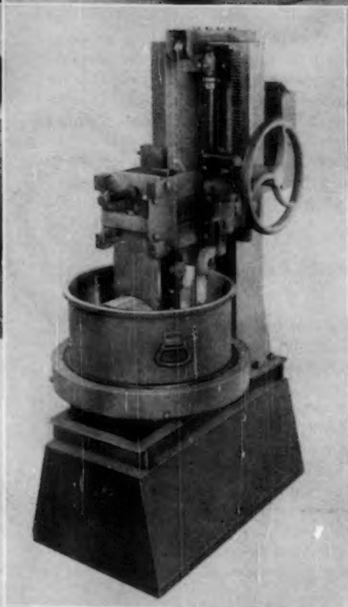
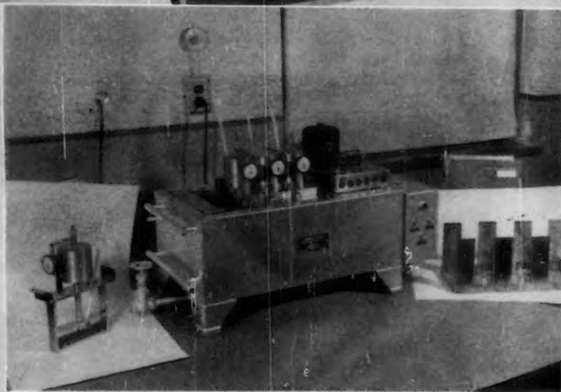
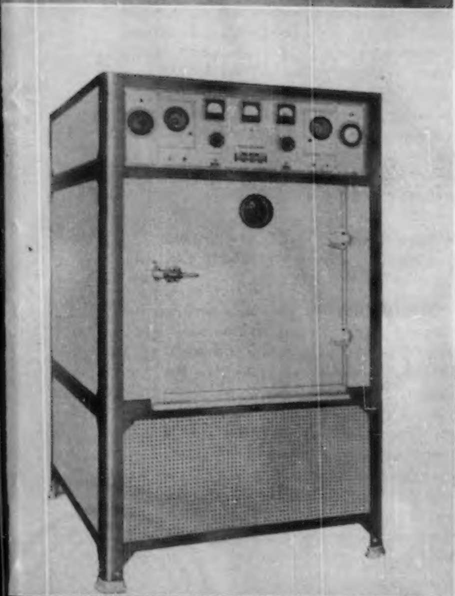
Sieburg Industries, Inc., will show its TensilkuT, designed for the precision machining of physical test specimens from all metals, plastics, and nonmetallics. Tensile, fatigue, compressive, or other shapes are duplicated with accuracies of ±0.0005 in. from 0.0005-in. foil or film as well as 0.500-in. plate. Test specimens are claimed to be completely devoid of cold working or heat deformation on the machined edges.

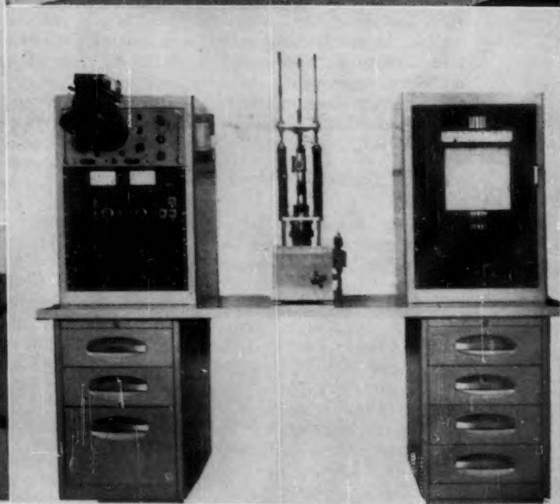
First row, left to right: fume hood, wall table, distillation rack; measuring and metallurgical microscope; electro-hydraulic tensile tester.

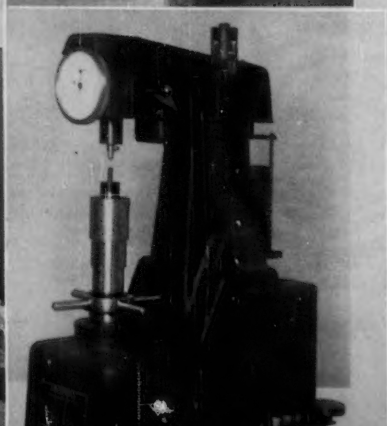
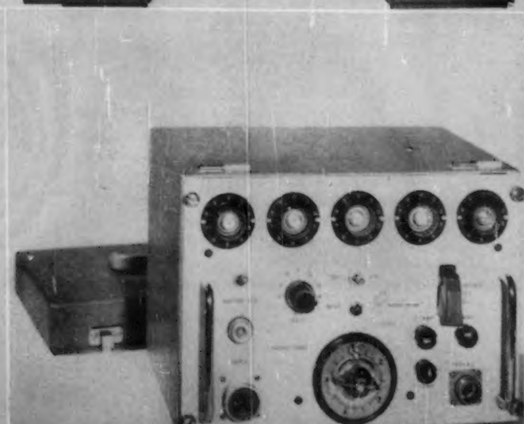
Second row, left to right: oxygen analyzer for steel, tungsten, titanium, and other metals and alloys; laboratory mixer with muller; heat distortion tester.

Third row, left to right: Weatherometer; delux polishing apparatus; high speed tester.

Fourth row, left to right: universal spectrophotometer; hardness tester; gage for moisture-content determination.



Soiltest, Inc.
Booth 42

Soiltest will exhibit a new portable concrete testing machine of 250,000 lb capacity; 30,000 lb capacity laboratory compression testing machine for plastics, rubber, wood, soils, and similar materials; new motorized sieve shaker; motorized cement briquet tester; portable compression and tension testing machine; laboratory test sieves; Volumeasure for in-place density tests of soils.

Sturtevant Mill Co.
Booth 17

Sturtevant Mill Co. will feature its automatic coal crusher and sampler capable of grinding a ton an hour of 2-in. coal to 8 mesh and finer; 5, 10, and 15 per cent being removed as truly representative sample. New splitter attachment takes 10 per cent of this sample for convenience in handling. Sturtevant Micronizer grinding machine is a fluid energy mill for reducing materials to low micron sizes. In shallow grinding chamber jet-propelled particles reduce themselves by impact, eventually splitting into micron sizes.

Tatnall Measuring Systems Company
Booths 14 and 15

Tatnall Measuring Systems Co. will feature a 6000 lb capacity creep testing machine completely equipped; a 75,000-lb hydraulic universal testing machine with built-in hydraulic programming equipment; and a 10,000-lb universal testing machine. Also operating will be a complete exhibit of PhotoStress apparatus, including the new self-balancing optical bridge demonstrated as a static and dynamic torquemeter, and color matching equipment. In addition, there will be other stress analysis apparatus and instrumentation adapted to the materials testing field.

Testing Machines, Inc.
Booth 1

Testing Machines, Inc., will display several new and unique instruments for use in rubber, plastics, paper, and packaging fields. Included will be representative instruments of the well-known Wallace line of rubber testers, including the dead load hardness tester, and also a new calibrating device for all standard durometers. Of interest to the plastic industry will be the NF Type triple-range impact tester, with special attachments for tension impact tests. There will be several items widely used in the paper industry, such as motor-driven micrometers, carton container testing equipment, and descriptive information regarding TMI's complete line of physical testing equipment.

TESTlab Incorporated
Booth 104

TESTlab will have table top consolidation testing apparatus that is completely self contained hydraulic dead load; light weight economical unconfined compression apparatus; new portable 125 ton cylinder compression tester; new improved pocket penetrometer; bar load indicators to replace load rings.

Thwing-Albert Instrument Co.
Booths 43 and 44

Thwing-Albert Instrument Co. will feature a number of new instruments recently developed for the paper, plastic, textile, adhesives, and printing ink industries. The Model 49RC tensile tester will be shown with many new improvements, grips, and fixtures developed especially for these industries. The Elmendorf tearing tester will be featured with three new attachments for testing impact, torsion, and toughness. The textile Elmendorf tearing tester will also be exhibited. Also shown will be the table-model pendulum-type tensile tester, meeting ASTM specifications and covering ranges up to 100 lb. For the adhesive industry the new T-A-C tester for testing tack, adhesion, and cohesion will be demonstrated. The ink penetration tester developed by the Hercules Powder Co. for testing coatings and sizing in paper will be on display. For the printing industry, the new Inkometer recorder will be shown. The Inkometer recorder removes the human element in taking readings. Also included in the exhibit will be the Egan slip tester which records or indicates frictional qualities of paper, plastic film, and other sheet materials.

Uddeholm Company of America, Inc.
Booth 20

Among the instruments to be shown in the Uddeholm booth will be the Disa Electro Polisher and the new attachment, the Movipol, with which it is possible to conduct portable electro polishing nondestructively on large immovable parts such as castings and forgings. Also displayed will be Knuth rotor wet pregrinder, Bergsman micro hardness tester, Zwick Z-323 low load hardness tester, D. P. Diamond polishing process, Nobel Institute calibration micrometer, and M & W linear structure counter.

United States Testing Co.
Booth 49

Certified and calibrated glassware, thermometers, and apparatus for research and quality control; standard and custom built testing instruments will be shown.

Unitron Instrument Division, United Scientific Co.
Booths 77–80

Visitors to the Unitron booth will have an opportunity to try for themselves a complete line of microscopes for research and industry. They are invited to bring their own microscope specimens and discuss their optical problems with Unitron's engineers. Instruments in operation will include the versatile Unitron Metallograph with cameras for $3^1/_4$ by $4^1/_4$ in., Polaroid, 35-mm and motion picture photography; vacuum heating stage attaining temperatures to 100 C; toolmaker's microscope measuring to 0.001 in. in three dimensions; inverted and standard metallurgical microscopes; plating-thickness microscope; as well as polarizing, stereoscopic, phase, binocular, and laboratory models. A section of Unitron astronomical telescopes will also be shown.

Delbert Wheeler
Booth 103

On display will be the improved Wheeler sieve shaker, unique in design; correct in principle; convenient; accurate; versatile; portable and quiet. It grades either coarse or fine-grained material; takes any standard make of sieves of various diameters; will accommodate nests from 10 to 18 in. in height and has a multitude of uses. The machine is suitable for testing in the laboratory, in the field, on construction jobs, in mines, and almost everywhere sieve tests are necessary.

S. S. White Industrial Division
Booth 39

The S. S. White Industrial Division will display an Industrial Airbrasive Unit which deburs, abrades, or cuts delicate material by a high-speed, gas-propelled stream of finely graded abrasive particles. This stream provides cool, fast, and shockless cutting action. This equipment is designed for hundreds of jobs, many on a mass-production basis. It may be used to cut germanium, shape fragile crystals, debur stainless steel, drill holes, etch, and groove glass.

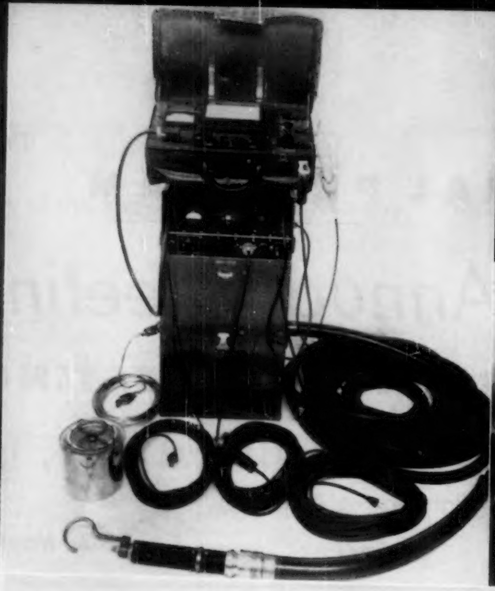
Wilson Mechanical Instrument Div., American Chain and Cable Co., Inc.
Booth 74

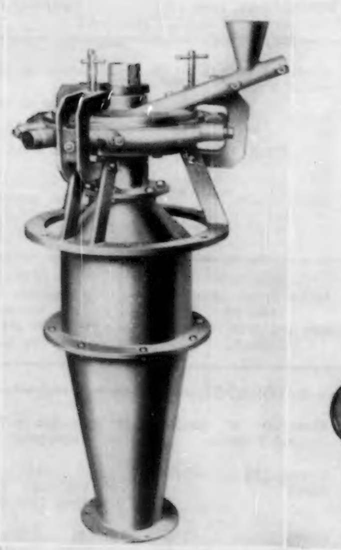
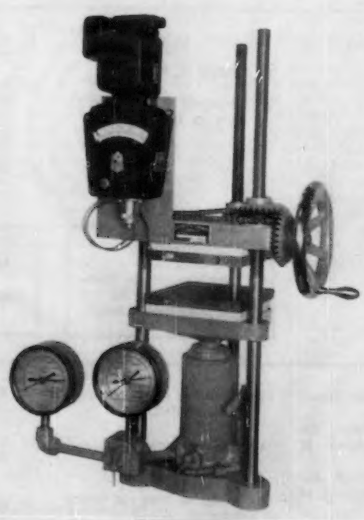
The Wilson display will feature hardness testing, its applications and apparatus. The new Rockwell TwinTester will be shown—designed primarily for use in laboratories, tool departments, maintenance repair shops, inspection departments, etc., requiring only limited use of hand-operated Rockwell testers, it can be changed from normal to superficial hardness testing procedures in seconds. Several other models of Wilson "Rockwell" hardness testers will also be shown, and information and literature will be available.

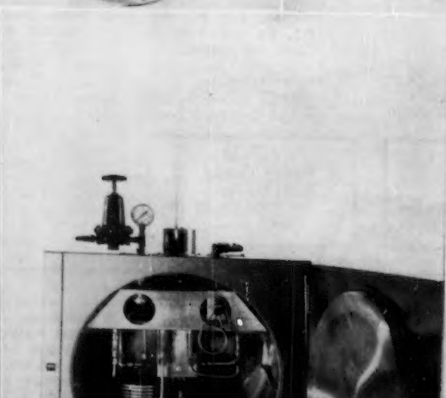
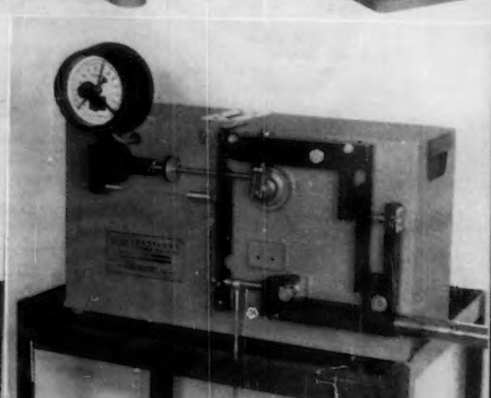
First row, left to right: ultrasonic thickness gage; field insulation power factor test set; ASTM colorimeter.

Second row, left to right: universal testing machine; micronizer grinding machine; 20-ton hydraulic press with platen, thermostat, and auxiliary hydraulic gage and valve; for in-place density tests of soils.

Third row, left to right: buret for micro titration; vapor-phase analyzer; lubricant-testing machine.

This Program is subject to change

PROVISIONAL PROGRAM

Sixty-first Annual Meeting

AMERICAN SOCIETY FOR TESTING MATERIALS

BOSTON, MASS. • JUNE 22–27, 1958

All time indicated is Eastern Daylight Saving Time

Committee Meetings held throughout the week

	MONDAY, June 23	TUESDAY, June 24	WEDNESDAY, June 25	THURSDAY, June 26	FRIDAY, June 27
MORNING	1 **Opening Session—Session on Fatigue**	9 **Session on Concrete** 10 **Session on Fatigue** 11 **Symposium on Radiation Effects on Materials**	21 **Symposium on Materials Research Frontiers** 22 **Session on High Temperature** (Jt. Comm. Effect Temp.) —11:15 a.m.— 23 **Report Session** (Reports B-1, B-2, B-5, B-8, B-9)	29 **Session on Soils** 30 **Session on Cement** 31 **Symposium on Particle Size Measurement** —11:30 a.m.— 32 **Report Session** Reports C-8, C-12, C-20, C-21, C-22, D-5, D-14)	39 **Symposium on Particle Size Measurement**
		—12:00 noon— 12 **Luncheon Session, President's Address, 40- and 50-year members, Awards**	—12:00 noon— **Road Materials Industry Luncheon** **Copper and Brass Industry Luncheon**	—12:00 noon— **Petroleum Industry Luncheon** **Instrument and Apparatus Industry Luncheon**	
AFTERNOON	2 **Symposium on Basic Mechanisms of Fatigue** 3 **Symposium on Some Approaches to Durability in Structures** 4 **Symposium on Solvent Extraction in the Analysis of Metals** —4:30 p.m.— 5 **Report Session** (Reports A-2, A-7, A-9, C-2, D-7, E-5, E-6, E-11)	13 **Symposium on Radiation Effects on Materials** 14 **Session on Textiles** (Report D-13) 15 **Session on Road and Paving Materials** —4:15 p.m.— 16 **Report Session** (Reports A-5, A-6, A-10, B-7, C-4, C-7, E-9, E-12, F-1, Adv. Comm. Corrosion)	24 **Symposium on Materials Research Frontiers** 25 **Session on Non-Ferrous Metals** —4:00 p.m.— 26 **Report Session** (Reports A-1, B-3, B-6, D-1, D-9, E-4, E-10, Jt. Comm. on Leather) 27 **Report Session** (Reports C-3, C-9, C-18, D-4, E-3)	33 **Symposium on Particle Size Measurement** —3:00 p.m.— 34 **Symposium on Paper and Paper Products** —4:30 p.m.— 35 **Report Session** (Reports B-4, D-17, D-21, D-22, D-23, D-24, E-1, E-2, E-7, E-13)	—12:30 p.m.— 40 **Report Session** (Reports A-3, D-2, D-3, D-10, D-11, D-12, D-16, F-2, D-20) 41 **Report Session** (Reports C-1, C-11, C-13, C-14, C-15, C-16, C-19, D-8) —2:00 p.m.— 42 **Symposium on Applications of Soil Testing in Highway Design and Construction** (Report D-18)
		—5:00 p.m.— 17 **Gillett Lecture** **Clyde Williams** **High Temperature Metals for the Future**	—4:30 p.m.— 28 **Marburg Lecture** **E. W. Pehrson** **Raw Materials for the Future**		
EVENING	6 **Symposium on Bulk Sampling** 7 **Session on Ferrous Metals** 8 **Session on Concrete**	18 **Session on High Temperature** 19 **Symposium on Effect of Water on Bituminous Paving Mixtures** 20 **Session on Crack Propagation**	**Cocktail Party** **ASTM Dinner** **Boston Pops Orchestra**	—7:30 p.m.— 36 **Symposium on Paper and Paper Products** (Report D-6) —8:00 p.m.— 37 **Symposium on Applications of Soil Testing in Highway Design and Construction** 38 **Symposium on Radioactivity in Industrial Water and Industrial Waste Water** (Report D-19)	

NOTE.—It is possible that some of the papers listed in the following provisional program will be presented by title only. Consult the final program for this information.

Monday, June 23 10:00 a.m. First Session

Opening Session

Formal Opening of the Sixty-First Annual Meeting. President R. T. Kropf

Session on Fatigue

Tentative Fatigue Strength Reduction Factors For Nonmetallic Inclusions in High Strength Steels. H. N. Cummings, F. B. Stulen, and W. C. Schulte, Curtiss-Wright Corp.

Tentative values of Fatigue Strength Reduction Factors for nonmetallic, nonmalleable inclusions in single-nucleus fractures of R. R. Moore rotating beam specimens are determined by two methods. Data for the computations are taken from tests on 309 specimens of SAE 4340 and 4350 steel, of 140, 190, 230, 260, and 300 kpsi ultimate tensile strength. Quantitative results are thought to be somewhere near the correct order of magnitude. Qualitatively, it is concluded that the values of the factors depend upon the size of the inclusions and upon the hardness level of the steel. Also, it is thought that for very small inclusions (less than 0.00025 in.) other inhomogeneities inherent in the steel itself dominate the failure of a specimen.

Distribution of Fatigue Failures in Flat Hardened Steel Test Bars. L. P. Tarasov, Norton Co., W. S. Hyler, and R. J. Favor, Battelle Memorial Institute.

This paper describes results of analysis of longitudinal, transverse, and depth distributions of fatigue nuclei in flat hardened steel bars whose surfaces had been prepared by various grinding and abrasive tumbling conditions. The mean longitudinal-fracture location was near the maximum stress section, and its location was insensitive to surface processing conditions, relative stress level, and whether failure nucleated at or below the surface. Transverse locations of nuclei were distributed nearly uniformly along the flat surfaces of the fatigue bars. The edge effect seemed unimportant.

The depth of nucleation was influenced by grinding and abrasive tumbling conditions. Subsurface failures were associated with those conditions that resulted in improved fatigue strength. Two types of inclusions were found at most subsurface failures; their effect on fatigue behavior was similar.

Torsional Fatigue Properties of Small Diameter High-Carbon Steel Wire. H. C. Burnett, National Bureau of Standards.

The torsional fatigue properties of small diameter, high-carbon, steel wire were investigated in three different types of test. In general, there was no direct correlation between these properties and the tensile strength of the wire. Comparison of a commercial, cold-drawn wire with wire from a vacuum-melted heat showed that the torsional fatigue life of cold-drawn wire is decreased by the presence of inclusions. It was also found that oil-tempered wire stressed in torsion is less susceptible to the initiation of longitudinal shear cracks than cold-drawn music wire. Shot peening greatly increased the fatigue life of springs coiled from all three types of wire.

A machine for determining the fatigue properties of wire stressed in torsion at constant amplitudes of strain is described. Good agreement was found to exist between the results obtained with this machine and the results on fatigue tests on compression springs.

Effects of Grinding Direction and of Abrasive Tumbling on the Fatigue Limit of Hardened Steel. L. P. Tarasov, Norton Co., W. S. Hyler, Battelle Memorial Institute, and H. R. Letner, General Electric Co.

The reverse-bending fatigue limit for flat test bars was not reduced when they were ground perpendicular, instead of parallel, to the direction of applied stress. Grinding with soluble oil under good commercial conditions actually resulted in a slightly higher fatigue limit for transverse than for longitudinal grinding. When a grinding oil was used instead, the fatigue limit was the same for both grinding directions. Abrasive tumbling after grinding longitudinally with either type of fluid raised the fatigue limit above the value obtained after grinding alone. These results are explained in terms of the surface strengthening associated with the residual stresses and cold work induced by the abrasive operations.

(Continued in Tenth Session)

Monday, June 23 2:00 p.m. Second Session

Held simultaneously with the Third and Fourth Sessions

Symposium on Basic Mechanisms of Fatigue

The general purpose of the symposium will be to emphasize new observations of the basic mechanisms that are operative in metals subjected to repeated stressing. Much of the test data in the literature is of an applied nature. There is a strong need for understanding the fundamental readjustments taking place in the crystalline structure to evolve new or revised theory. Better concepts of the readjustments within slip systems and the correlation of these with the generation and movement of dislocations and vacancies are needed to assist in developing rational and practical methods of machine design. The papers will cover a variety of new observations made with the assistance of special techniques including photoelastic, damping, X-ray, and electron microscope studies.

Dislocation Behavior in Lithium Fluoride Crystals During Cyclic Stressing. R. E. Keith and J. J. Gilman, General Electric Co.

Since etching techniques capable of revealing the positions of individual dislocations in LiF are available, this material is useful for making detailed studies of the dislocation processes involved in deformation under various types of specimen loading. Results obtained on LiF are found to be in general agreement with the observed behavior of dislocations in other ionic crystals, oxides, semiconductors, and metal systems.

This paper describes experimental observations made on cyclically-loaded, LiF single crystals. These observations include behavior of individual dislocations during stress reversal, the development of glide bands by dislocation multiplication processes, the lengthwise and lateral growth of bands, changes in the surface contour of the specimens resulting from the presence of certain types of bands, and interactions between bands. The range of cycles studied extended from a few cycles to several million cycles.

Fatigue Behavior in Shear of Oriented Magnesium Monocrystals. R. W. Armstrong and G. T. Horne, Carnegie Institute of Technology.

Fatigue testing of oriented magnesium crystals was accomplished in such a manner as to approach conditions of alternately reversed shear. The applied shear stress necessary to produce visible cracks within a given number of cycles was investigated under such conditions.

The effect on crack initiation and propagation of several testing and specimen variables was qualitatively investigated.

Finally, a metallographic study was made of the specimens tested to allow discussion of the test results with respect to the plastic deformation preceding and during the appearance of cracks.

Cycle-Dependent Stress Relaxation. Jo-Dean Morrow and G. M. Sinclair, University of Illinois.

Time-dependent relaxation of stress in metal which is held in a strained state is a well-known phenomenon. There also exists a cycle-dependent relaxation of stress which occurs under conditions of repeated straining. To investigate this type of behavior, the mean strain and amplitude of alternating strain is held constant in axial fatigue tests of SAE 4340, and the mean stress is measured as a function of the number of strain repetitions. An analysis utilizing an assumed dynamic stress-microstrain relationship is employed to study the relaxation in terms of the condition of the material, and the initial and control conditions of the test. The practical significance of these findings is discussed, especially as relates to the fading of residual stresses in machine parts subjected to fatigue loading.

Internal Friction, Plastic Strain, and Fatigue in Metals and Semiconductors. W. P. Mason, Bell Telephone Laboratories.

By using a barium titanate driver attached to a tapered brass horn, containing a sample of a metal, it is possible to stress the sample to fatigue. The internal friction and plastic strain of the sample can be measured from the ratio of the driving voltage to a pickup voltage from the titanate and from the resonant frequency. It is found that there are two amplitude ranges for which the internal friction and plastic strain vary with amplitude. The final phase for metals results in a very rapid rise in internal friction and plastic strain, ending in fatigue. The effect of a static stress is to lower the value of the alternating stress required for fatigue. Germanium does not fatigue in the manner of a metal, but suffers brittle fracture. A theory, based on the action of Frank-Read dislocation loops, is shown to agree with all the measured results. Fatigue stresses can be increased by metallographic treatments which reduce the lengths of the Frank-Read sources.

Observations Relating to a Proposed Mechanism of Fracture by Fatigue. W. A. Wood, University of Melbourne.

The mechanism of fatigue fracture is viewed in the light of recent observations resulting from a modified, taper-sectioning technique which shows the contour of slip bands under effective magnifications of 10,000 to 20,000 ×. The observations show in detail just how a metal may disintegrate in the deformation zones associated with slip bands. They are illustrated by examples from copper and brass, metals in which it is practicable to etch up deformation zones in sectioned fatigue test-pieces.

A Study of Fatigue Crack Formation in Silver Chloride. P. J. E. Forsyth, Royal Aircraft Establishment.

Silver chloride specimens have been fatigued in reverse plane bending in order to observe the formation of defects and the propagation of cracks. The photolytic effect in this material has been utilized to reveal dislocations associated with fatigue deformation. Observations have also been made on the slip band extrusion and intrusion that occurs when this material is subjected to fatigue stress and a comparison between the behavior of this material and that of an aluminum alloy is made.

Slip-Band Formation and Fatigue Cracks of Different Materials Under Alternating Stressing. Max R. Hempel, Max-Planck Institut für Eisenforschung.

The paper deals with the phenomena of deformation in specimens subjected to alternating stress. These studies treat the formation and the propagation of slip bands at room temperature. Unnotched specimens of body-centered-cubic and a face-centered-cubic metal were tested in plane bending at a frequency of 1500 cpm. The deformation structure of slip traces on identical areas of the free surfaces was studied in relation to the loading conditions, especially stress level and fatigue life, by means of the light microscope. Some of the slip bands could not be removed by the method of repolishing and etching a fatigued specimen after different stages in a fatigue test. By using a plastic replica and by observation in an electron-microscope it is shown that minute crack traces occur on the surface of slip bands.

Monday, June 23 2:00 p.m. Third Session

Held simultaneously with the Second and Fourth Sessions

Symposium on Some Approaches to Durability in Structures

Durability in structures has received consideration by both the buyer and the builder for many years. Progress in improving structures from the standpoint of cost to give expected service with beauty of design has necessitated new engineering approaches which could predict service life. The older materials and techniques had service records which appealed to conservative buyers, but growing costs encouraged consideration of newer approaches to building techniques. In evaluating these, durability, as a part of safety for people and property, has become of prime importance. Correlations between tests and field experience show no great agreement in engineering circles, particularly over the significance of test results, even if the competitive sales aspects are discounted. These presentations are directed toward correlations between tests of some commonly used structural materials and the effects of weather on them, in hopes that future methods of test for durability might have more general acceptance among structural engineers and code authorities.

Some Factors Affecting Durability of Structural Clay Product Masonry. P. V. Johnson, Structural Clay Products Research Foundation, and H. C. Plummer, Structural Clay Products Institute.

Durability of structural clay product masonry is discussed relative to both masonry units and wall constructions. The effect of design and construction techniques on the resistance of walls to damage from exposure to natural forces, such as rain penetration and frost action, is established and correlation between laboratory tests and field experience is cited. Factors, such as the degree of dimensional stability under various exposure conditions and the destructive action of crystallization of salts, which may affect the durability of the masonry units, are also discussed with reference to both laboratory and field observations.

Laboratory Testing and the Durability of Concrete. T. B. Kennedy, U. S. Army Engineers, Waterways Experiment Station.

It is not feasible to subject concrete structures to full-scale tests for durability in a manner analogous to load tests. It therefore is necessary to estimate durability by combining information gained from a study of service yielded by existing structures, controlled exposure tests of specimens, laboratory simulated-service tests, and tests and analyses of concrete and concrete materials. Petrographic examination of aggregates, X-ray diffraction studies of cement, freezing-and-thawing tests of concrete, both in the laboratory and at field exposure stations, and pulse velocity tests of specimens and structures are recommended means of improving knowledge of durability of concrete and concrete structures.

Durability Tests of Structural Sandwich Constructions. E. W. Kuenzi and L. W. Wood, U. S. Forest Products Laboratory.

This paper presents the results of tests and a discussion concerning the behavior of structural-sandwich constructions having facings of plywood, hardboard, cement-asbestos board, aluminum, and porcelainized-steel faced hardboard on cores of resin-treated paper honeycomb. The construction and behavior of the sandwich in a structural unit erected ten years ago are discussed. Also presented are results of accelerated-aging exposures that might be considered for predicting the durability of such constructions.

The Durability of Buildings: A Discussion of Some General Aspects. R. F. Legget and N. B. Hutcheon, National Research Council.

The durability of buildings is a subject of timely importance in view of current changes in building design. The meaning of the term is explored. This leads to the suggestion that the amount of durability wanted in a building must be faced by the designer. Correspondingly, it is demonstrated that the durability of a building is really the durability of its components. The interrelation of building components can only usefully be considered in relation to the climatic environment, interior and exterior, in which the building is to serve, and this suggests some of the limitations of testing for durability.

Effect of the Atmosphere on Masonry and Related Materials. J. W. McBurney, Consultant.

Except for corrosion of metals, rather little attention has been given to air as a possible factor in disintegration. The common assumption is that all the deleterious substances which in time produce disintegration or excessive volume change in masonry were present originally in the units or in the mortar ingredients as delivered and used. This paper considers the effect on masonry of such components of the air as carbon dioxide, alkali and alkaline earth salts, usually sodium, potassium, calcium, and magnesium compounds, and moisture, as rain or as vapor, expressed as relative humidity.

Relation Between Actual and Artificial Weathering. F. W. Reinhart, National Bureau of Standards.

The factors that affect the correlation of outdoor exposure tests with laboratory-simulated weathering tests on materials will be discussed. Laboratory tests can be controlled fairly well. However, outdoor exposure tests are at the mercy of the weather. The temperature, relative humidity, sunshine, and rain vary, not only from one geographical location to another, but also at the same location, from month to month and from year to year. These variations are of sufficient magnitude so that actual outdoor exposure tests cannot be considered at a standard for rating the performance of laboratory-simulated (artificial) weathering tests.

Monday, June 23 2:00 p.m. Fourth Session

Held simultaneously with the Second and Third Sessions

Symposium on Solvent Extraction in the Analysis of Metals

(In cooperation with the Chemical Division of the American Society for Quality Control)

Great interest has been engendered in the past several decades in solvent extraction separation methods. Their simplicity, speed, convenience, and versatility have earned for extraction techniques a favored place among separation methods of interest to analysts. General aspects of metal extractions will be briefly discussed. A classification of metal extraction systems based on the nature of the extractable species will be presented in outline.

Convergence of Tie Lines in Ternary Liquid Systems—Application to Liquid Extraction. R. L. Pilloton, Electro Metallurgical Co., Division of Union Carbide Corp.

A number of phase diagrams for ternary systems consisting of water, a mineral acid, and an organic solvent are presented. The shapes of the binodal curves and the slopes of the tie lines in these diagrams are discussed. In order to generalize the findings, a mathematical discussion is presented to demonstrate that tie lines of ternary liquid systems converge to one point when the concentrations of the components are related by certain equations. A method for calculating the position of the point of convergence of tie lines is presented. Several examples of application of this method are given. The meaning of the convergence point is discussed (1) in terms of its relation with the Gibbs-Duhem equation, (2) for predicting separations which are possible by liquid extractions.

Metals Analysis with Thenoyltrifluoroacetone. F. L. Moore, Oak Ridge National Laboratory.

The role of 2-thenoyltrifluoroacetone (TTA) in metals analysis is reviewed. The principle of the liquid-liquid extraction technique involving TTA is discussed. A survey of extraction systems using TTA in metals separations is presented. Radiochemical procedures based on this versatile chelating agent have been used successfully on the Atomic Energy Project for several years. Details for the specific determination of radiozirconium, radiocerium, plutonium, and neptunium are described and illustrate the application of the techniques of solvent choice, acidity, variation of metal oxidation state, the use of masking agents, and washing and stripping of the organic phase to effect high selectivity in TTA liquid-liquid extraction procedures. Recent investigations on the extraction of iron and niobium from strong acid solution are discussed.

The Use of Tri-*n*-Octylphosphine Oxide in Analytical Chemistry. J. C. White, Oak Ridge National Laboratory.

Tri-*n*-octylphosphine oxide $(C_8H_{17})_3PO$, abbreviated TOPO, when dissolved in inert hydrocarbon solvents, has been shown to be a versatile reagent in the liquid-liquid extraction of certain metals from acidic solutions. The extraction of a given ion is affected by not only the particular acid anion present in the solution, but by its concentration too. For example, ferric iron is extracted only when sufficient chloride ion is available. Ferrous iron is not extracted under any condition. In all, 17 elements are extractable under the proper conditions: uranium, chromium, tin, zirconium, gold, hafnium, thorium, molybdenum, antimony, bismuth, indium, iron, titanium, niobium, arsenic, mercury, and platinum. In nitrate or nitric acid solutions the number of extractable metals is reduced to five: chromium, tin, uranium, gold, and zirconium.

8-Hydroxyquinaldine Extractions Applied to the Analysis of Metals. R. J. Hynek, Allis-Chalmers Manufacturing Co.

The extraction behavior of 8-hydroxyquinaldine with various metal ions has been studied and has led to new analytical methods. Of particular interest is a method for aluminum. 8-Hydroxyquinaldine, which does not react with aluminum, is used to eliminate interfering ions by extraction from an alkaline media. This paper also includes a discussion of a recently developed rapid method for lead. This method is based on the extraction of lead 8-hydroxyquinaldinate from an alkaline cyanide-hydrogen peroxide media.

The Role of Organic Solvents in Flame Photometry. J. A. Dean, University of Tennessee.

The combination of organic solvent extraction and flame spectrophotometry presents advantages. Large increases in emission intensity, sometimes exceeding 100-fold, are achieved through extraction of the test element(s) into an organic phase and aspirating that phase directly into an oxygen-fuel flame. Rapid and accurate analyses can be performed of elements, such as aluminum, which possess emission lines of low intensity in aqueous solution, or of elements with strong emission lines, but which may be present in the sample only as minor components. Serious interferences from large amounts of matrix elements or reagents added during the preparation of the sample are eliminated. Extraction and flame spectrophotometry should be attractive to laboratories considering emission spectrography but whose work loads, diversity of sample compositions, or cost factors have mitigated against its adoption.

Monday, June 23 4:30 p.m. Fifth Session

Committee Report Session

A-2 on Wrought Iron. L. S. Crane, Chairman.

A-7 on Malleable-Iron Castings. W. M. Albrecht, Chairman.

A-9 on Ferro-Alloys. S. W. Poole, Chairman.

C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements. E. S. Newman, Chairman.

D-7 on Wood. L. J. Markwardt, Chairman.

E-5 on Fire Tests of Materials and Construction. W. J. Krefeld, Chairman.

E-6 on Methods of Testing Building Constructions. R. F. Legget, Chairman.

E-11 on Quality Control of Materials. H. F. Dodge, Chairman.

Monday, June 23 8:00 p.m. Sixth Session

Held simultaneously with the Seventh and Eighth Sessions

Symposium on Bulk Sampling

The main purpose of the symposium is to provide further understanding of sampling to those persons charged with the responsibility of preparing specifications involving sampling.

A second objective is to give persons, faced with the interpretation of specifications and results based on sampling, a few rules to help prevent gross mistakes in making decisions.

All too often the purposes and the consequences of the recommended sampling procedure are not clearly thought out and for this reason the results may be misinterpreted in terms of the specifications. There is clearly a need for better planning in the preliminary stages of the materials' testing program before the specifications are set.

The symposium will include a paper on the purposes of sampling to emphasize the importance of giving full consideration to the object of the specification. More technical papers will be given on measurement error, sample size, and sample reduction.

The Purposes of Bulk Sampling. W. E. Deming, New York University.

Studies in Ore Car and Abrasive Grain Sampling Variation. R. S. Bingham, Jr., J. L. Gioele, and V. B. Shelburne, The Carborundum Co.

Practical solution of a bulk sampling problem follows a stepwise procedure. Model hypothesis, experiment, test, and development of a new hypothesis is vital to the solution. Two case histories demonstrate the procedure.

The first describes a study of ore received in box cars. Particle size and chemical composition were examined to develop a car-acceptance plan. Fifteen samples from each of two cars from two vendors were taken. The variability of samples within cars, among cars from the same vendor, and between vendors was established.

The second describes a study of two thief-sampling methods for approving finished hoppers of alumina abrasive. The sampling and screening variation was evaluated. Testing errors introduced by sifting machines, screens, and operators were appraised. Next, a mathematical model associated with the physical grain handling was postulated, tested by experiment, and denied. Another model is hypothesized from the data.

Measurement Error Considerations in Bulk Sampling. A. J. Duncan, Johns Hopkins University.

There is a need for clear demarcation and definition of problems. The universe about which inferences are to be made will be defined as well as the mean and variance of the universe. Various causes of the deviations of estimates from universe values will be discussed including rounding off measurements, variations between physical measurements of the same material, and variations due to sampling from nonuniform material. Statistical methods for analyzing components of variance will be the focal point of the paper and will consist of an exposition of components of variance analysis for simple models. Numerical illustrations will be used to supplement any algebraic analysis. Statistical methods for controlling deviations discussed will include randomness in sampling to yield coefficients of risk, use of unbiased estimates, use of efficient sampling techniques, and sample size.

Influence of Increment Weight on Variance. W. M. Bertholf, Colorado Fuel and Iron Corp.

In a perfectly mixed lot, variance will be inversely proportional to the increment weight—speaking of sampling variance only. In a completely segregated lot, variance of increments of any weight will be constant. Between these two extremes of the "state of mixing" many intermediate relationships can, and will, be observed. If we consider the parent lot to be a continuous strip from which we from time to time abstract relatively small cross-sections, we may consider the observed variance of these cross-sections to be due to a combination of two main effects, (1) failure of the cross-section to match its immediate surroundings and (2) change of the character of the material from time to time, and the relative and absolute magnitudes of these two effects will determine the position and shape of the *variance versus weight of increment curve.*

Data are presented which indicate that it is possible to rank roughly a series of coals as to probable sampling difficulty, if one has some knowledge of the type of coal and the way it was handled prior to sampling.

An Interpretation of the Enos Coal Sampling Data as an Example of Bulk Sampling. B. A. Landry, Battelle Memorial Institute.

An attempt is made to relate the components of variance to such fundamental properties of the coal particles as their inherent and extraneous ash. It is assumed that the unit variance (the random component) is related to variation in inherent ash. The trend variance (the segregation component) is related to the proportion of extraneous ash in the coal. These indications are extended to the requirements for proper reduction of the sample to laboratory size for analysis.

Monday, June 23 8:00 p.m. Seventh Session

Held simultaneously with the Sixth and Eighth Sessions

Session on Ferrous Metals

Microstructure. Mary R. Norton, Watertown Arsenal.

The Effects of Strain Rate and Temper Rolling on the Strain-Aging Characteristics of Rimmed, Annealed Steel. D. H. Fisher and R. L. Carlson, Battelle Memorial Institute, and W. T. Lankford, United States Steel Corp.

Tensile tests were performed to investigate the effects of strain rate and temper-rolling extension on the strain-aging characteristics of low-carbon sheet steel. The effects after aging times of 29, 150, and 800 hours were investigated for two amounts of temper-rolling extension (1.2 per cent and 2.3 per cent) at strain rates varying from 0.001 per second to 0.4 per second. Commercially temper-rolled material was used, and all tests were performed at room temperature.

The results of the study are summarized by plots that depict the variation of the stress-strain behavior with varying strain rate, amount of temper rolling, and aging time. The significance of the indices used to describe the results is discussed in terms of the history of the test specimens and the strain rate. Yield-point phenomena and work-hardening characteristics are found to be markedly affected by history and the strain rate, and emphasis is directed toward relating the observed behavior to the mechanics of plastic flow.

Toughening High Strength Steel by Warm Working. E. J. Ripling, Continental Can Co.

The poor room temperature toughness displayed by some metals results because these materials have transition temperatures above room temperature. Methods for improving the toughness of these metals, such as by increasing the tempering temperature in heat-treated steels, usually lowers their yield strength. It is shown that toughening, accompanied by an increase in yield strength, is possible by proper prestraining. The toughness of SAE 1340 steel at high-strength levels was improved two to sevenfold by warm working. This was accompanied by an appreciable increase in yield strength, by a slight increase in tensile strength and ductility, as well as by a mild loss in hardness. A somewhat smaller toughness improvement, accompanied by a smaller hardness loss, was found in warm worked SAE 4340 steel.

Effect of Size on the Yielding of Mild Steel Beams. C. W. Richards, Stanford University.

Like the strength of a brittle material, the upper yield point in mild steel is subject not only to wide variations of a random nature but also to systematic variations depending on specimen size. Dependence on size in simple tension has been shown to exist. The theory is here extended to the case of pure bending.

A statistically designed and carefully controlled experiment provides test for the significance of a number of variables including size. Analysis of variance indicates that size is the only significant effect present. Further study reveals a substantially linear relationship between the logarithms of size and yield strength. This is in agreement with the statistical theory and provides further support for the brittle fracture analogy for the yielding of mild steel.

Stress-Rupture and Creep Properties of Malleable Iron at Elevated Temperatures. L. C. Marshall and G. F. Sommer, Link-Belt Co.

Experimental data are presented on high-temperature, stress-rupture, and creep properties of malleable irons, both ferritic and pearlitic, in the range which covers most such applications, to 2000 hr, between 600 and 1200 F. Curves of stress versus logarithm rupture time show no breaks in maximum test periods. This, with careful metallographic inspection, supports the conclusion that all material tested exhibits only highly ductile properties and small likelihood of transitions or structural changes. Complete information has been derived, which is being employed in preparation of a proposed use specification and will be presented. The data indicate that many pearlitic and standard malleables now manufactured compare favorably with other cast materials on the market, including a number with varying alloy compositions.

Hysteresis and Anelasticity in Cold-Worked Stainless Steel. J. D. Lubahn, General Electric Co.

Creep and cyclic loading tests on cold-stretched, stainless steel show that the hysteresis in cyclic loading is not an anelasticity phenomenon. The practical significance of this hysteresis as a possible source of damping is discussed.

Monday, June 23 8:00 p.m. Eighth Session

Held simultaneously with the Sixth and Seventh Sessions

Session on Concrete

Reflectance Tests for Concrete Curing Materials. C. C. Rhodes, M. H. Janson, and M. G. Brown, Michigan State Highway Department.

Three general factors enter into the development of a significant and practical reflectance test for concrete curing materials: (1) spectral distribution of solar radiation received at the earth's surface, (2) spectral characteristics of the curing materials, and (3) suitability of various photometers for measurement of reflectance in the most significant spectral range. An analysis of these three factors indicates that measurements, in the visible range are as significant as those in the infrared, and that ASTM Method E 97 yields more representative values than can be obtained in the infrared with instruments readily available at a reasonable cost.

Extending Concrete Highway Durability with Silicones. H. L. Cahn and R. V. Mackey, Jr., General Electric Co.

The primary objectives in highway construction are safety and durability. Silicones contribute significantly in both areas, but they are a major factor in extending durability of concrete highways.

The known water-repellent properties of silicones on masonry indicated considerable potential in making concrete highways weather-resistant, thus minimizing maintenance costs. Laboratory tests substantiated these conclusions, and field tests proved that silicone treatment of these roadways markedly reduced water absorption and minimized consequent freeze-thaw damage to the concrete.

Furthermore, treated concrete retains its color, even when wet, thus maintaining light reflectance values very near to those of the dry road. The added safety factor is obvious.

Testing of Prestressing Materials and Concrete Control on the Northern Illinois Toll Highway. J. J. Waddell, Joseph K. Knoerle & Associates, Inc.

This paper presents a brief description of the methods and procedures used to achieve control of high-quality concrete construction. Petrographic tests of aggregates, finish screening of coarse aggregates, and semiautomatic batching plants were all conducive to uniform high quality concrete. Strength tests were analyzed statistically for control of the cement content and analysis of operations.

Techniques were developed for testing fabric pads for bridge bearings, making tensile tests of 7-wire prestressing strand, control of stressing operations when both straight and deflected strands were used, and making compressive strength tests of zero slump concrete.

Sulfate Resistance of Portland-Pozzolan Cement Concretes. Milos Polivka and E. H. Brown, University of California.

Concrete exposed to sulfate waters or alkali soils generally exhibits a rapid rate of deterioration because of the expansive forces developed during the crystallization of sulfoaluminates. Reported are results of a research program on the effectiveness of representative pozzolanic materials in improving the resistance of concretes to sulfate attack. Cementing materials employed included a type I and type V portland cement, and three pozzolans, namely a calcined shale, a pumicite, and a fly ash. Comparisons are made of the effect of the initial curing period and types of exposure. Also discussed are four methods employed to evaluate sulfate resistance. It is concluded that the most satisfactory test procedure consists of complete immersion in the selected sulfate solution; that the most consistent indication of potential resistance is obtained from a photographic record in conjunction with observations of weight loss; and that the use of an effective pozzolan in concretes will improve their sulfate resistance.

(Continued in Ninth Session)

Tuesday, June 24 9:30 a.m. Ninth Session

Held simultaneously with the Tenth and Eleventh Sessions

Session on Concrete (*Continued*)

Long-Time Creep and Shrinkage Tests of Plain and Reinforced Concrete. G. E. Troxell, J. M. Raphael, and R. E. Davis, University of California.

An investigation of creep and drying shrinkage of concrete has been in progress for nearly 30 yr. Many specimens were 4-in. diameter, unsealed cylinders loaded in compression to 800 psi at 28 days and thereafter stored in air at 50 per cent RH. Both creep and shrinkage continued to increase during the entire period. Sixty-four to 83 per cent of the total creep and 66 to 85 per cent of the total shrinkage during 20 yr occurred within one year. Creep increased with a higher water-cement ratio and with a lower aggregate-cement ratio but shrinkage was not appreciably affected by these variables. Both creep and shrinkage of concrete were greater for type IV than for type I cement. The creep for sandstone concrete was more than double that for limestone concrete and the shrinkage of sandstone concrete was more than double that for quartz concrete.

Other test variables reported on include the age at loading, the applied stress, moisture conditions of storage, and size of specimen.

The Effect of Fine Aggregate Characteristics Other than Grading on Strength and Durability of Concrete. J. G. Dempsey, Compania Anonima De Concreto.

The effect on mortar strength and durability of the characteristics of fine aggregate other than grading is examined through tests of sand-cement mortars made at equal water-cement ratio and containing enough sand so that consistency is the same for all batches. The investigation indicated that the cement factor of a cement-sand mortar varies with the roughness, sharpness, and regularity of the surfaces and edges of a natural sand with a fixed gradation, while strength and durability do not necessarily vary proportionally with the amount of cement. The tests confirm the generally held opinion that the durability of a mortar varies inversely with its water requirement, and that the generally accepted shape and surface factors have definite significance in defining sand of superior quality.

The Effect of Type of Capping Material on the Compressive Strength of Concrete Cylinders. George Werner, Bureau of Public Roads.

The effect of capping materials on the compressive strength of 6 by 12-in. concrete cylinders is reported in this paper. The capping materials used included the high-alumina cement, high-strength gypsum plasters, and sulfur cements permitted by ASTM Methods C 31 and C 192, as well as plaster of Paris, a mixture of plaster of Paris and portland cement, and plain sulfur. The cylinders were molded, cured, and tested in the laboratory under standard conditions.

For the high-strength concrete, the cylinders capped with high-alumina cement had the greatest compressive strength. The lowest strengths for this class of concrete were obtained for cylinders capped with plaster of Paris or the mixture of this plaster and portland cement. The strengths of cylinders capped with the other five materials varied from 76 to 98 per cent of the strength of cylinders capped with high-alumina cement.

Compressive strengths and sonic modulus of elasticity are reported for each of the eight capping materials.

Flexural and Compressive Strength Properties of Air-Entrained Concrete with Blast-Furnace Slag Aggregate. D. W. Lewis and Fred Hubbard, National Slag Association.

Eight sources of blast-furnace slag were used in air-entrained concrete subjected to flexural and compressive strength tests up to an age of one year. In addition to variations in physical properties of the aggregates variables of cement content, curing condition, aggregate size, and cement type were incorporated in tests with the standard, or reference, aggregate. The results show no consistent correlation of strength with physical properties of the aggregates such as unit weight or abrasion loss. Changes in cement content had more effect on compressive than on flexural strengths; rate of strength gain was greater in compression after seven days; and the compression test is indicated to be more reproducible. At constant cement content, aggregate sizes from ¾ to 2-in. produced comparable strengths. Concrete with ⅜-in. top size aggregate was weaker.

Tuesday, June 24 9:30 a.m. Tenth Session

Held simultaneously with the Ninth and Eleventh Sessions

Session on Fatigue (*Continued*)

A Mechanism for Nonpropagating Fatigue Cracks. L. F. Coffin, Jr., General Electric Co.

Recent investigations on fatigue of metals have revealed the presence of nonpropagating fatigue cracks formed at the base of sharp notches under cyclic stress conditions. It has similarly been observed that a sharp notch is a more severe stress raiser in fatigue than a fatigue crack. A mechanism is proposed to explain these observations, whereby the stress and strain in the base of the notch are fully reversed under the action of an external cyclic load, but where for a crack, full reversal does not occur because of closure of the crack and reduction of the accompanying stress concentrating effects. The cyclic plastic strain, rather than stress, is used to compare conditions in notches and cracks. The mechanism predicts properly the effect of a superimposed mean stress on the propagation or nonpropagation of fatigue cracks in notched bars.

A High Temperature Vacuum and Controlled Environment Fatigue Tester. G. J. Danek, Jr. and M. R. Achter, U. S. Naval Research Laboratory.

Equipment has been developed for reverse-bending fatigue at elevated temperature in vacuum. To simulate thermal stresses, the apparatus was operated to produce large strain amplitudes at low frequencies. A major problem in the design of such equipment, the transmission of motion through a vacuum seal, was circumvented by the use of a magnetic coupling driven at the resonant frequency of the specimen. Provision has been made for automatically stopping the test when a crack has developed through the use of a thyratron circuit. Fatigue data are presented for type 316 stainless steel in vacuum through a range of stresses at 1500 F.

Tuesday, June 24 9:30 a.m. Eleventh Session

Held simultaneously with the Ninth and Tenth Sessions

Symposium on Radiation Effects on Materials

(Jointly sponsored with Subcommittee on Radiation Effects of Atomic Industrial Forum)

The following abstracts are short summaries of papers to be presented at the Third Annual Radiation Effects Symposium cosponsored by ASTM and Atomic Industrial Forum. It is presented as an extension of the Forum's purpose of aiding industries entering the relatively new nuclear field, and the ASTM's procedures in establishing industrial standards for manufacturers and users.

The symposium is divided into three categories:

1. Dosimetry for Radiation Effects Programs.
   (a) Theory.
   (b) Practice.
2. Radiation Facilities and Techniques for Testing Irradiated Materials.
3. Radiation Effects to Various Materials.
   (a) Reactor Materials.
   (b) Other Materials.

The first category will present the theory of dosimetry as applied to radiation effects programs, and some methods in use today for measuring radiation fields and energy absorbed in materials placed in these fields. The second category will describe some of the newest irradiation facilities and one new method for testing irradiated materials. The third category will present some new data on radiation effects to materials used in reactors, and various other materials.

I. Dosimetry Considerations

Units and Concepts of Radiation Dosimetry. L. L. Smith, Nuclear Corporation of America.

Dosimetry Techniques for Gamma and Reactor Radiation Fields. Paul Schall, Jr., and J. F. Kircher, Battelle Memorial Institute.

It is the object of this paper to compare several methods of dosimetry under two conditions, a pure gamma field and a reactor radiation field. Since total doses of less than about 10^4 rads are not generally encountered in radiation-effects programs, those dosimetric systems designed for work below this value are not considered.

Several of the better known dosimetric techniques, such as the use of ion chambers, chemical dosimeters, foils, etc., are considered in some detail. The applicability of the various systems in the two types of radiation field are compared and discussed. In addition, some newer techniques currently under investigation in various laboratories are reviewed.

II. Irradiation Facilities and Techniques

Irradiation Facilities in NRU. G. C. Laurence, Atomic Energy of Canada Ltd.

National Research Universal (NRU) is the new 200 megawatt, 3×10^{14} neutron per sq cm per sec research reactor at Chalk River. This paper describes its facilities for irradiation. They are designed for high heat output and easy replacement of the irradiated materials without interrupting reactor operation. For example, 10-ft long experimental fuel assemblies releasing 2000 kw can be irradiated in loops in the core and replaced with reactor at full power. Small capsules of material for irradiation are replaced by a pneumatic carrier. Generous provision is made for cooling irradiated materials in the annular space around the core, in experimental beam holes, and in the thermal column. Other facilities are described.

The Engineering Test Reactor as an Irradiation Facility. R. L. Doan, Phillips Petroleum Co.

The ETR has nine major irradiation facilities incorporated directly in the reactor core and running the entire 36-in. length of the fuel elements. One is 9 in. square, one is 6 by 9 in., three are 6 in. square, and four are 3 in. square. At design power of 175 thermal megawatts the average above-thermal flux over the core is estimated as 2×10^{14} neutrons per square centimeter per second. The paper will summarize the operational status of the reactor and outline the general types of experimental equipment being installed in the various core and reflector positions.

A Description of the Proposed Sandia Engineering Reactor Facility. J. L. Colp, Sandia Corp.

The Sandia Engineering Reactor Facility consists of a 5-megawatt, light-water, moderated, heterogeneous-type, nuclear reactor, a large, dry-irradiation room, and the necessary laboratory space for the preparation and post-irradiation testing of material samples. This facility will be used to study the effects of radiation on the engineering properties of materials. Equipment for producing additional environments of heat, cold, altitude, and vibration will be available for compounding with the radiation environment during material tests.

An In-Pile Fatigue Testing Apparatus. E. E. Drucker, Syracuse University.

A compact, automatic apparatus for fatigue testing with controlled strain has been designed and tested out-of-pile. Fatigue tests are possible under controlled strain, frequency, temperature, and environment within a nuclear reactor, with a very high degree of reliability. The simultaneous testing of two or three specimens, is possible in a facility such as a 4 by 4 in. experimental hole of the Brookhaven graphite pile.

Pure tension or compression loads are applied by a thermal actuating tube, which is alternately heated and cooled to produce saw-tooth or trapezoidal-shaped strain cycles. Frequencies of 10 cpm with 1 per cent strain are possible, and larger strains with lower frequency. Fracture faces are preserved for subsequent inspection, and an automatic standby control system is provided.

(Continued in Thirteenth Session)

Tuesday, June 24 12:00 noon Twelfth Session

Luncheon Session—President's Address, Introduction of New Officers, 40-Year and 50-Year Members Recognition, Report of Board of Directors, Awards

Tuesday, June 24 2:30 p.m. Thirteenth Session

Held simultaneously with the Fourteenth and Fifteenth Sessions

Symposium on Radiation Effects on Materials (Continued)

III. Studies on Radiation Effects

Reactor Pressure Vessel Design for Nuclear Applications. N. Balai, R. E. Bailey, and T. L. Kettles, Argonne National Laboratory.

The high nuclear radiations (gamma rays, thermal and fast neutrons) and the steep power transients which are easily attained require much additional consideration in the design stage of nuclear-reactor pressure vessels because of limitations imposed by materials of construction.

The designer is concerned with: (a) start-up heating and shutdown cooling transient rates, (b) nonuniform thermal gradients in the pressure vessel under steady-state operations, (c) transmutations in the pressure vessel engendered by thermal neutrons, (d) radiation damage to the pressure vessel by the fast neutron bombardment, (e) corrosion resistance of the pressure vessel and the character of the corrosion products. (f) impact loadings on the pressure vessel in service, and (g) special provisions as dictated by the type of core and moderators employed and contemplated.

Fast Neutrons and the EBR-I Core Flow Separator. R. E. Bailey, Argonne National Laboratory, and M. A. Silliman, Atomic Power Development Associates.

The type 347, stainless steel flow separator which contained the core and axial blanket elements of the Experimental Breeder Reactor I was studied to determine the mechanical properties of this material after actual reactor operations resulting in a maximum exposure of 2×10^{21} *nvt*. An electric arc discharge cutter was adapted for remote cutting of test specimens. Hardness, strength, ductility, and electrical resistivity measurements were made along with photomicrographs of the metal after various heat treatment. Hardness and tensile specimens were annealed at temperatures between 400 and 740 C to determine the feasibility of restoring this material to its pre-irradiation ductility and strength at temperatures which might be obtained in a reactor. Samples of the original plate from which the flow separator was fabricated were available for control purposes.

Control Materials for Pressurized Water Reactors. W. K. Anderson, D. N. Dunning, and W. E. Ray, General Electric Co.

Damage caused by whole pile radiation to a number of control materials, usable in power producing nuclear reactors is discussed. These materials include several boron alloys, boron carrying cermets, cermets or dispersions of rare earth oxides in stainless steel or titanium, and cadmium-indium-silver alloys. The effects discussed include mechanical property changes, swelling, and changes in corrosion resistance of the various materials. The conclusion is reached that materials are at present available which should satisfactorily control the present crop of power-producing reactors.

Radiation Behavior of Fuel Materials for Sodium Graphite Reactors. B. R. Hayward, L. E. Wilkinson, and C. C. Woolsey, Atomics International.

An experimental program is under way, using the Sodium Reactor Experiment (SRE) to evaluate the behavior of metallic and nonmetallic fuel materials under the conditions of irradiation and temperatures of interest to operation of a sodium-cooled, graphite-moderated nuclear power plant. Several dilute alloys of uranium, an alloy of thorium and uranium (5 to 10 per cent of highly enriched uranium), and unalloyed uranium are being studied. Also, uranium oxide is being studied as an alternate to the metallic fuels.

Tests of some of these materials have been conducted in the Materials Testing Reactor (MTR) with experimental conditions designed to achieve the temperature conditions anticipated for the SRE. Results of these tests will also be included.

Irradiation of Uranium-Fissium Alloys and Related Compositions. K. F. Smith, Argonne National Laboratory.

Results of neutron irradiation of uranium-molybdenum and uranium-fissium alloys in the range near one half per cent burnup and 500 to 600 C are presented.

The term "uranium-fissium" is used to denote certain alloys of uranium with its fission products, made, not as a result of irradiation, but by conventional alloying methods.

Under the stated conditions both classes of alloys show quite low growth and volume coefficients, with a few exceptions. Water quenching of either alloy from 850 C is shown to be an unsatisfactory treatment. The effect of an axial hole in specimens for the relief of fission gases appears to be inconclusive.

Surface condition of irradiated uranium base alloys appears to be somewhat rougher than that for uranium-20 weight per cent plutonium base alloys.

Radiation Effects on Jet Engine Lubricating Oils. C. G. Collins, General Electric Co.

The paper presents a general description of the property changes produced in synthetic base jet engine lubricants by irradiation. Following a brief review of the types of changes that occur in organic fluids and of the relative stability of different types of compounds, emphasis is placed on engineering property changes in MIL-L-7808 lubricants. A comparison of the results of specification tests on the lubricants before and after irradiation shows that particular problem areas include coking and corrosion. A significant reduction of the oxidation-induction period is also found when the measurement is made during irradiation. Typical data are presented showing the results under various radiation rates.

The Effects of Nuclear Radiation on Natural Quartz Piezoelectric Crystals. F. E. Graham and A. F. Donovan, Admiral Corporation.

This paper discusses the effect of nuclear radiation on quartz crystals. The crystal units used in the investigation were constructed from natural Brazilian quartz, and are used for the precise determination and control of frequencies in communication and associated equipment. Parametric measurements of the equivalent electrical circuit of the crystals were made before, during, and after irradiation. All irradiations took place at the CP-5 research reactor of the Argonne National Laboratory. Selected crystal units were also irradiated at the Admiral Corporation's Co^{60} gamma facility in order to evaluate gamma damage effects.

Some Observations on the Effects of High Neutron and Gamma Fluxes on the Transmission Characteristics of Some Optical Glasses. J. L. Colp, Sandia Corporation.

This paper discusses irradiation tests at very high neutron and gamma fluxes on several different samples of optical glasses. Included in these tests have been several samples of radiation-tolerant, optical glasses provided by several, optical-glass manufacturers. Engineering data on the transmission properties of these samples before and after sustaining several levels of irradiation have been recorded. Curves showing the effect of these irradiations on the transmission of light at various frequencies will be presented.

Tuesday, June 24 2:30 p.m. Fourteenth Session

Held simultaneously with the Thirteenth and Fifteenth Sessions

Session on Textiles

Report of Committee D-13 on Textile Materials. B. L. Whittier, Chairman

Data Under Difficulties. E. R. Schwarz, Massachusetts Institute of Technology.

A disturbing amount of data is obtained under circumstances which make adequate observations imperfect or impossible. It is seldom possible when working with laboratory equipment, to do more than estimate intervals in time or space to the nearest half scale division. If intervals are changed, then the length and spacing of intervals, starting points, and end points, must be estimated. Certain details may be obscured partially or totally by reason of interposition of relative amplitudes and velocities of motion.

Preconceived ideas have an influence. This paper discusses these matters in terms of demonstration and examples, and points out the importance of the trained observer in testing and research.

[Several additional talks on textiles will be presented]

Tuesday, June 24 2:30 p.m. Fifteenth Session

Held simultaneously with the Thirteenth and Fourteenth Sessions

Session on Road and Paving Materials

Determination of Degree of Stripping by Water of Asphalt from Aggregate by the Tracer Salt Method. A. B. Brown, Standard Oil Co. (Ind.).

An objective method is outlined for determination of degree of stripping of asphalt from aggregate by water. The evaluation is free of most of the mechanical and subjective errors inherent in visual appraisal. The method is based on surface impregnation of the test aggregate with a minute quantity of a water-soluble lithium tracer salt, subjecting the aggregate to the usual bitumen coating and water stripping operations, and determining by means of a flame photometer, the concentration of lithium in the stripping water. The tracer salt dissolves in proportion to the stripped surface.

Field Experience and Laboratory Study of Slow-Setting Paving Grade Asphalt in Airfield Pavement Construction. R. A. Chisholm and D. D. Fenton, U. S. Army Corps of Engineers.

A Laboratory Method for Determining the Skidding Resistance of Bituminous Paving Mixtures. J. W. Shupe and W. H. Goetz, Purdue University.

This paper lists the desirable features that should be included in a laboratory method for determining the skidding resistance of a pavement surface, and describes the laboratory skid-test apparatus resulting from an endeavor to incorporate these desirable features into its design. This equipment measures the frictional force developed between a rubber shoe and a test specimen for a relative speed between the two surfaces of approximately 30 mph.

Also described is a test procedure with related instrumentation for simulating the wear and polishing effect that a pavement surface receives under the action of traffic.

Results include a field correlation study performed on 18 different bituminous surfaces, as well as laboratory studies indicating the progressive decrease, due to wear, in the skidding resistance of bituminous surfaces containing different types of aggregates.

Effect of Ultraviolet Light on Thin Films of Paving-Grade Asphalts. R. F. Sparlin, Ken R. White, Consulting Engineers.

This paper presents a discussion and review of literature concerning deterioration of asphalt binders in service and in the laboratory, and it reports the results of limited laboratory experiments carried on in an attempt to evaluate the effect of ultraviolet light as a destructive agent. Though the tests conducted were quite limited, covering only a few samples of two paving asphalts, the results indicate that ultraviolet energy of the particular wavelength described in the paper is capable of producing measurable increases in viscosity in films of asphalt which are sealed from the atmosphere. The hardening of an asphalt binder is discussed in terms of the separate, and sometimes interrelated reactions of oxidation, volatilization, thixotrophy, syneresis, polymerization, and the action of radiant energy.

Suitability of Lightweight Aggregate to the Manufacture of Bituminous Plant Mix. J. C. Wycoff, Southern Lightweight Aggregate Corp.

Using a reasonably well-graded 3/8 in. to 0 lightweight aggregate, Hubbard-Field tests, as described by the Asphalt Institute and in Compressive Strength of Bituminous Mixtures (ASTM D 1074–55), were performed at varying asphalt content. The results of these tests were very respectable. Hubbard-Field tests of over 3500 lb and compressive strengths of over 350 psi were obtained using 11.0 to 11.5 per cent 85/100 penetration asphalt. The second consideration was the effect of water on bituminous mixtures using this type aggregate. Mixes tested in accordance with methods described in Effect of Water on Cohesion of Compacted Bituminous Mixtures (ASTM D 1075–54) showed an index retained strength of 89.1 per cent. A field test strip four lanes wide and 200 ft long was placed on Route 360 in Richmond, Va., Nov. 19, 1957.

Tuesday, June 24 4:15 p.m. Sixteenth Session

Committee Report Session

A-5 on Corrosion of Iron and Steel. Marc Darrin, Chairman.

A-6 on Magnetic Properties. A. C. Beiler, Chairman.

A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys. Jerome Strauss, Chairman.

B-7 on Light Metals and Alloys, Cast and Wrought. I. V. Williams, Chairman.

C-4 on Clay Pipe. D. G. Miller, Vice-Chairman.

C-7 on Lime. J. A. Murray, Chairman.

E-9 on Fatigue. R. E. Peterson, Chairman.

E-12 on Appearance. George Ingle, Chairman.

F-1 on Materials for Electron Tubes and Semiconductor Devices. S. A. Standing, Chairman.

Advisory Committee on Corrosion. K. G. Compton, Chairman.

Tuesday, June 24 5:00 p.m. Seventeenth Session

Gillett Memorial Lecture

High Temperature Metals—Their Role in the Technological Future. Clyde Williams, President, Clyde Williams & Co. Formerly President of Battelle Memorial Institute.

This Lecture, established in 1951, is jointly sponsored by ASTM with Battelle Memorial Institute. It commemorates Horace W. Gillett, one of America's leading technologists and metallurgists and the first Director of Battelle. The Lecture is delivered annually at a meeting of the Society, the first one having been given at the Fiftieth Anniversary Meeting, June, 1952. The Lecture will cover subjects pertaining to the development, testing, evaluation, and application of metals. [See abstract on p. 7.]

Tuesday, June 24 8:00 p.m. Eighteenth Session

Held simultaneously with the Nineteenth and Twentieth Sessions

Session on High Temperature

Effect of Strain-Rate and Temperature on the Strength of Magnesium Alloys. R. W. Fenn, Jr., and J. A. Gusack, The Dow Chemical Co.

Investigation of the effect of strain-rate (0.005, 0.05, 0.5, and 5 in. per in. per min) on the strength of several rolled, extruded, and cast magnesium alloys at temperatures up to 900 F reveals significant increases in strength with increased testing speed. This study provides information for use in design of structures subjected to rapid loading. It also points out the need for standardized testing speed in elevated temperature testing.

Aging Characteristics of Nickel-Chromium Alloys Containing Appreciable Amounts of Titanium and Aluminum. N. J. Grant and N. E. Rogen, Massachusetts Institute of Technology.

This investigation was concerned with the aging characteristics and high-temperature strength properties of vacuum-melted, wrought nickel-chromium-titanium-aluminum alloys. The aluminum plus titanium content of these simple alloys varied from four to six weight per cent and the titanium to aluminum ratio varied from 1.0 to 1.6. Phase identification, particle size, and lattice parameter measurements were made on electrolytically extracted precipitates. The variation of hardness with annealing temperature and time was studied and correlated with the particle-size data. Finally, the stress-rupture properties were measured and an attempt was made to relate the high-temperature-strength properties to the aging characteristics exhibited by these alloys.

High Temperature Properties of Nickel-Al_2O_3 Alloys. W. S. Cremens, U. S. Air Forces in Europe, formerly Massachusetts Institute of Technology, and N. J. Grant, Massachusetts Institute of Technology.

Utilizing fine nickel powders down to 1 to 2 microns, blended with Al_2O_3 from 0.2 to 0.02 micron, extrusions were made to produce alloys containing up to 45 volume per cent of Al_2O_3. These products have been tested in tension at room temperature and in creep rupture at 1300 to 1800 F. The interparticle spacing of the Al_2O_3 in the alloy is related to the measured mechanical properties. Large increases in rupture strength are noted with decreasing interparticle spacing at 1500 F.

A Machine for the Evaluation of High Temperature Alloys Under Combined Static and Dynamic Stresses. P. E. Hawkes, General Motors Corp.

A resonance type, elevated-temperature testing machine imposing a static or stress-rupture loading combined with a high-frequency, fluctuating, flexural stress on specimens has been developed to serve as an aid in the development of new high-temperature alloys. The frequency of the alternating stress is in the range of 450 to 650 cps. Specimens are made small enough so that they may be machined from actual parts such as turbine buckets and thus incorporate the true metallurgical structure of the service part. Results of tests on two high-temperature alloys, A286 at 1100 F and GMR 235D at 1800 F are included to illustrate the utility of the machine. Data are presented as modified, Goodman-type diagrams as well as three-dimensional diagrams incorporating axes of static loading, dynamic loading, and time.

(Continued in Twenty-Second Session)

Tuesday, June 24 8:00 p.m. Nineteenth Session

Held simultaneously with the Eighteenth and Twentieth Sessions

Symposium on Effect of Water on Bituminous Paving Mixtures

Bituminous pavement failures are sometimes attributed to stripping of bitumen from the mineral aggregates due to a moist environment. Reasons for this unpredictable behavior are being sought by many investigators. Antistripping compounds to be added to the asphalt are being widely used. Observation of roads in service and the opinions expressed by observers are not entirely consistent, except that some asphalt-aggregate combinations appear to give better performance under moist conditions than others. The authors in this Symposium will discuss some of the latest thinking on the effect that each component, including environment, may contribute to the service behavior of bituminous paving mixtures and methods that have been studied in an attempt to evaluate tests intended to predict such behavior.

Field Observations of the Behavior of Bituminous Pavements as Influenced by Moisture. W. K. Parr, University of Michigan.

The treatment of this subject covers pavements of the following types: surface treatments (seal coats), mixed macadams, dense-graded cold mix, and dense-graded hot mix, and describes from both personal experiences and through correspondence with engineers from representative states and provinces, producers cities, and counties, examples of their field behavior in the presence of moisture at the time of construction and in service. The paper classifies such behaviors, analyzing them as to the type of failure, the materials involved, and construction practices. From this survey a summary is made of the types of behavior which have been observed due to moisture and what contributing factors are associated with the behavior.

Relationship of Aggregate Characteristics to the Effect of Water on Bituminous Paving Mixtures. J. M. Rice, National Crushed Stone Assn.

This paper reviews the important literature concerning the adhesion of bituminous materials to aggregates in the presence of water. It deals with the classification of rocks, and their mineralogical and chemical composition. The important properties of the aggregates which are believed to affect the water-resistance of bituminous-coated aggregates are discussed. These are, in addition to composition, surface texture, surface coatings, particle size, and surface area, porosity and absorption, chemical reactivity, and surface energy. The significance of these properties is then evaluated in relation to three prevalent theories regarding the water resistance of bituminous-coated aggregate, that is, the chemical reaction theory, the interfacial energy theory, and the mechanical theory. The environment of the aggregate in the pavement is also considered.

Laboratory and Field Tests on Asphalt Paving Mixtures. E. W. Klinger and J. C. Roediger, Esso Research and Engineering Co.

Accelerated laboratory tests are being used to evaluate the "adhesivity" of an asphalt, that is, its resistance to displacement from aggregate surfaces by water. In these static immersion type tests, the consistency of the asphalt, as well as the type and condition of the aggregate, affects the results. Thus, the selection of the proper test conditions is difficult.

To establish whether a correlation exists with field performance, comparisons have been made of a static immersion test with circular track tests and with the behavior of pavements under normal traffic conditions. The study included paving grade and cutback asphalts, with and without additives, used in surface treatment, road mix, and plant mix construction.

The static immersion test usually predicted the *initial* ability of cutback asphalt to coat and adhere to damp or wet aggregate. However, no correlation with pavement service performance was evident in the twelve year period of field observations. Under the conditions to which the experimental pavements were exposed, the various adhesion promoters did not exhibit the life improvement indicated possible by the circular track tests. Thus, new laboratory methods must be developed which are based on satisfactory correlation with long time observations of pavements exposed to traffic.

Effect of Additives. P. F. Critz, Bureau of Public Roads.

Chemical agents are presently being marketed commercially as aids in coating aggregates with bituminous materials used cold or at relatively low temperatures as well as those used at elevated temperatures required for hot-mix, hot-laid bituminous pavements. Such materials are reportedly resistant to deterioration when subjected to the periods or temperatures of heat to which they are normally subjected in use.

This report describes the study of nine commercial additives of this nature that have been offered to the Bureau for test and the results that have been obtained. It indicates that the additives tested remained effective under the laboratory test conditions imposed. Bituminous mixtures in which they were used retained greater resistance to moisture as measured by the immersion-compression test than did identical mixtures that did not contain an additive.

Methods of Testing for Water Resistance of Bituminous Paving Mixtures. W. H. Goetz, Purdue University.

Proposed methods of test designed to measure or evaluate the resistance of bituminous paving mixtures to the deleterious effects of water have varied from basic measurements of interfacial tension to simulated traffic tests. Deficiencies associated with artificial coating and curing conditions, artificial water exposure, exposure conditions for accelerated action, etc. are common to many of the tests reviewed. Methods for which correlation with road service is claimed require special equipment not normally found in highway and material laboratories. There remains, then, the need for a small-scale laboratory test of a quantitative nature which can be correlated with actual field performance.

Tuesday, June 24 8:00 p.m. Twentieth Session

Held simultaneously with the Eighteenth and Nineteenth Sessions

Session on Crack Propagation

The Response of High Strength Steels in the Range of 180,000 to 300,000 psi to Hydrogen Embrittlement from Cadmium Electroplating. E. P. Klier, B. B. Muvdi, and George Sachs, Syracuse University Research Institute.

The embrittlement of seven high-strength steels due to the action of hydrogen introduced by cadmium electroplating has been studied in sustained load tests. Strength levels from 180,000 to 300,000 psi as suitable for the various steels were examined for a variety of initial conditions of stress concentration. All steels were found to be embrittled in some measure after cadmium plating.

It can be predicted that in the absence of other embrittling factors hydrogen embrittlement due to electroplating should be reduced as the specimen size is increased. Limited data for SAE 4340 steel support this prediction.

Failure promoted by cadmium plating is affected by the experimental conditions and has been discussed at length in the report. In the hydrogen-bearing zone a crack is initiated and then, depending on the experimental conditions, may propagate to failure of the cross-section through overloading. Crack developent is apparently dependent, in part, on the composition and is minimized by reduction in carbon content or by an increase in silicon content.

The Charpy Low-Blow Transition Temperature. C. E. Hartbower and G. M. Orner, Watertown Arsenal Laboratories.

A definition of the Charpy, low-blow, transition temperature and the hypothesis underlying the technique used for its determination, in which a separation is made between the crack initiation and crack propagation stages of fracture, are presented. Data are presented to demonstrate that this transition is independent of notch and specimen geometry and of other test variables. Thus, it is considered to be of fundamental significance.

A quantitative correlation between the low-blow transition temperature and the onset of self-propagating cracking in conventionally impacted Charpy specimens is demonstrated.

Fracture Strengths Relative to Onset and Arrest of Crack Propagation. G. R. Irwin, J. A. Kies, and H. L. Smith, U. S. Naval Research Laboratory.

The stress conditions which control spreading of a deeply embedded tensile crack are essentially those of plane strain. Methods of duplicating these conditions in fracture strenth, G_c, measurements are illustrated by results from bend tests with a sharp notch on the tension side and from circumferentially notched tensile bars.

When large plastic contractions occur parallel to the crack edge the situation may be termed one of generalized plane stress. The corresponding fracture strengths, G_c, are much larger than for plane strain and are, in certain materials, more sensitive to strain rate and temperature. Plane stress fracture strength measurements under a variety of conditions are discussed.

Size Effects in Slow Notch Bend Tests of a Ni-Mo-V Steel. J. D. Lubahn and S. Yukawa, General Electric Co.

Slow notch bend tests were performed on specimens of various sizes and notch radii cut from large Ni-Mo-V steel forging.

High strength values were obtained for either a small specimen with a sharp notch or for a large specimen with a mild notch, but the combination of large specimen size and sharp notch resulted in nominal strengths as low as 40,000 psi. The notch-root strain at fracture decreased with increasing size of geometrically-similar specimens. A static crack appears to cause no more weakening than a sharp machined notch.

The tests also serve to show the effects of notch depth, testing temperature, hydrogen content, and proximity of welds.

Wednesday, June 25 9:30 a.m. Twenty-First Session

Held simultaneously with the Twenty-Second Session

Symposium on Materials Research Frontiers

The needs of a rapidly changing technological era are crowding hard upon the physical and chemical limitations set by available engineering materials. In every area of advancement—new construction designs; faster, lighter, more powerful engines and machines; higher temperature processes and reactions; nuclear science and engineering; and aircraft and missile development—the demand is for ever higher performance in the materials involved. Some of the country's most competent talent is engaged in the search for better fundamental understanding of the properties of matter and its translation into materials of improved utility.

Outstanding leaders in materials research will discuss accomplishments in their respective fields that are helping to meet pressing challenges of the present and will assist us to prepare for the unfolding future.

Tailoring the Properties of Materials. E. P. Stevenson, Arthur D. Little, Inc.

Man's progress has always depended upon the quality of the tools and equipment; these in turn have been only as good as the materials available to him. All too often advancement has been impeded or blocked because of material limitations. Chemical theory, developments in solid state physics, and the basic knowledge evolved from study of the fundamental structure of matter now provide the understanding by which we can exercise a considerable degree of control over the properties of materials. Among familiar and recent developments are synthetic plastics and textiles with characteristics never matched in nature; glass and ceramic bodies of startling new properties, alloys that out-perform any ordinary metal, semiconductors, cermets, high-energy fuels, and chemical compounds that can be made almost to order. All of these are examples of how we are learning more and more to meet our growing needs by tailoring the properties of materials through use of an expanding body of knowledge.

Molecular Engineering. Arthur von Hippel, Massachusetts Institute of Technology.

Instruments in Materials Research. B. H. Billings, Baird-Atomic, Inc.

In an age of satellites and space flight we are faced with a whole new environmental area to which materials and instruments will be exposed. Conditions will be encountered which will impose new restrictions as well as offer new freedoms and opportunities. Temperatures of the vehicle and external parts will be determined largely by radiation characteristics of the surfaces. Solar radiation may introduce problems normally not encountered at the earth's surface. Since a space vehicle will be under an external pressure far lower than anything attained on earth, electron guns and electronic devices of all kinds can be mounted and operated openly upon exterior of the vehicle. Numerous new possibilities are thus offered to the instrumentalist.

(Continued in the Twenty-Fourth Session)

Materials in the Nuclear Age. J. J. Antal, Watertown Arsenal.

Ages in these United States are marked by technological development, and technological development necessitates increased demands for adequate materials. The Nuclear Age has pressed us to a new limit by offering a vastly different kind of energy which must be controlled and contained by materials. The handling of billions of minute, extremely energetic particles has pointed up inadequacies in present-day materials and inadequacies in our knowledge of the interaction of these particles with materials. Materials proudly designed to have the proper balance of physical properties for the usual environments stiffen, corrode, and disintegrate while handling this new-found energy. Research thus far has provided many of the necessary materials, and it is now possible to venture into the use of nuclear energy for transportation and community power purposes. Most of this advance has been founded upon knowledge gained early through applied materials research. New basic knowledge of materials, in particular with respect to the effects produced by bombarding particles is necessary if we hope to conquer the majority of problems which remain. A review of the behavior of metals and insulators in the presence of bombarding nuclear particles as we now understand it, and a review of our basic knowledge of the mechanisms of this behavior, as viewed on a microscopic scale, make up the subjects of this paper.

Wednesday, June 25 9:30 a.m. Twenty-Second Session

Held simultaneously with the Twenty-First Session

Session on High Temperature (Continued)

Temperature and Time Stability of M257 and SAP Aluminum-Aluminum Oxide Alloys. W. S. Cremens, U. S. Air Forces in Europe, formerly Massachusetts Institute of Technology, E. A. Bryan and N. J. Grant, Massachusetts Institute of Technology.

The 6 to 8 per cent Al_2O_3(M257) alloy and the 10 to 14 per cent Al_2O_3(SAP) alloy in the system Al-Al_2O_3 were cold worked up to 66 and 29 per cent, respectively, after which they were annealed for various periods of time near the melting point. The effect of cold work, annealing time, and temperature on the resultant tensile, yield, and ductility values are reported, and the effect on the 600 F stress-rupture properties were examined. These alloys show remarkable structure stability at temperatures just below their respective melting temperatures and resist recrystallization.

A Study of the Variability in the Mechanical Properties of Grade A Phosphor Bronze Strip. M. N. Torrey, G. R. Gohn, and M. B. Wilk, Bell Telephone Laboratories, Inc.

This paper describes the use of an incomplete Latin square design for studying the variability in the physical and mechancial properties of grade A phosphor bronze strip. The experiment was designed so that the

over-all variability can be partitioned into (1) variability among columns (along the length of the strip), (2) variability among rows (across the width of the strip), (3) variability among milling lots, and (4) residual variability. The actual design used is given together with the method of analyzing the observed data and the test results obtained.

A by-product of the experiment is a comparison of different characteristics in the same group of specimens with respect to variability, for example, proportional limit values showed greater residual variability than did the tensile or 0.2 per cent offset yield strength values.

The Creep Properties of Three Low-Shrinkage, Copper-Base Casting Alloys. W. F. Simmons and J. G. Kura, Battelle Memorial Institute.

This paper gives the results of a creep evaluation of cast specimens of 80-10-10, 85-5-5-5, and Navy "M" alloys at 350, 450, and 550 F. Most of the tests were conducted for a period of 2000 hr. At one temperature for each alloy, the creep tests were carried out to 10,000 hr duration. Creep-rupture tests were also made at this temperature.

Short-time, room-temperature tensile tests were made on creep-tested specimens to determine the residual tensile properties after the long-time exposure to stress and temperature.

Mechanical and Physical Properties of Three Low-Shrinkage, Copper-Base Casting Alloys. J. G. Kura, Battelle Memorial Institute, and R. M. Lang, Douglas Aircraft Co., Inc.

The objective of the work was to provide accurate measurements for various mechanical and physical properties of the casting alloys described in ASTM Specification B 143-52, (Alloy No. 2A), ASTM Specification B 144-52 (Alloy No. 3A), and ASTM Specification B 62-52 which are known by the trade designations as Navy "M," 80-10-10, and 85-5-5-5, respectively. An additional objective was to show the properties that are available in these alloys that could be duplicated by the average brass foundry that employs good foundry practice.

Several properties were measured on coupons from test-bar castings at several temperatures, from −40 to 550 F, including ultimate tensile strength, yield strength, elongation, reduction of area, modulus of elasticity, compressive strength (at 0.001, 0.010, and 0.100 in. set). V-notch, Charpy impact strength, and Brinell hardness. Other properties measured were density and specific gravity, machinability, patternmaker's shrinkage, melting range, and fatigue strength. Electrical resistivity, thermal conductivity, and thermal expansion were also measured over a range of temperature.

Prediction of Long-Time Creep with Ten-Year Creep Data on Four Plastic Laminates. W. N. Findley and D. B. Peterson, Brown University.

Report of Joint Committee on Effect of Temperature on the Properties of Metals. V. T. Malcom, Chairman.

Wednesday, June 25 11:15 a.m. Twenty-Third Session

Committee Report Session

B-1 on Wires for Electrical Conductors. D. Halloran, Chairman.

B-2 on Non-Ferrous Metals and Alloys. Bruce W. Gonser, Chairman.

B-5 on Copper and Copper Alloys, Cast and Wrought. G. H. Harnden, Chairman.

B-8 on Electrodeposited Metallic Coatings. C. H. Sample, Chairman.

B-9 on Metal Powders and Metal Powder Products. J. L. Bonnano, Chairman.

Wednesday, June 25 12:00 noon

Copper and Brass Industry Luncheon

Sponsored by Committees B-2 on Non-Ferrous Metals and Alloys and B-5 on Copper and Copper Alloys, Cast and Wrought.

Speaker: R. A. Wilkins, Vice President, Revere Copper & Brass Inc.

Wednesday, June 25 12:00 noon

Road Materials Industry Luncheon

Sponsored by Committees C-1 on Cement, C-9 on Concrete and Concrete Aggregates, D-4 on Road and Paving Materials, and D-18 on Soils for Engineering Purposes.

Speaker: John A. Volpe, John A. Volpe Construction Co.

Wednesday, June 25 2:00 p.m. Twenty-Fourth Session

Held simultaneously with the Twenty-Fifth Session

Symposium on Materials Research Frontiers (Continued)

Recent Advances in Polymer Research. Herman Mark, Polytechnic Institute of Brooklyn.

The use of new-type ionic catalysts in anhydrous systems permits the control of the propagation reaction of vinyl addition polymerization and leads to isotactic or syndyotactic macromolecules. These have a more regular structure and hence a higher tendency to crystallize than their atactic counterparts. This manifests itself in appreciably different physical properties, thus permitting such materials to be used in entirely new applications. New methods in the preparation of block and graft copolymers have led to many new products with interesting applications in the field of elastomers, coatings, adhesives, and textile finishes. Progress in the characterization of polymers in the condensed state was made by the application of magnetic resonance methods, small angle X-ray diffraction, light scattering, and dynamic testing. Improved understanding of the mechanical and rheological behavior of polymers is provided by a new version of the theory of the relaxation spectrum of macromolecules.

Modern Liquid Fuels. A. L. Lyman, California Research Corp.

As major suppliers of energy for our national economy, the petroleum industry has a continuing challenge to anticipate the types and volumes of liquid fuels that will be required in the future. Meeting the demand as it arises is dependent upon the state of technology of manufacture and use of the fuels that can be obtained from crude petroleum. Examples are presented to illustrate recent problems regarding quality or availability of selected fuels. The solutions of these problems are indicative of the approach which will be used to meet future situations.

New Advances in Physical Metallurgy. W. R. Hibbard, General Electric Co.

Recent advances in metallurgical research such as new texture in silicon-iron alloys, brittle fracture as related to dislocation theory and synthetic structure, and high-temperature alloys will be discussed. Consideration will include the role of solid state science and the impact of Russian science and technology. Problems associated with education and manpower will also be described.

Recent Developments in Glass Research. W. W. Shaver, Corning Glass Works.

Research in glass has provided new compositions with broad ranges of properties and thousands of new useful products. As a consequence the old definition of glass as a "hard, transparent, brittle material" has been transformed into the concept of glass as a new class of engineering materials. The development of a series of photosensitive glasses is presented as an example of recent research effort. Subsequently a new field of materials, completely unrelated in the sense that photosensitive phenomena are entirely absent, was discovered as a result of an appreciation of the mechanism involved in certain phases of the earlier work. These materials, known as glass-ceramics, begin their existence as glasses but are transformed by subsequent heat treatment into crystalline materials. Glass ceramics have most interesting properties and give promise of many useful applications. They are described in detail in the paper.

Wednesday, June 25 2:00 p.m. Twenty-Fifth Session

Held simultaneously with the Twenty-Fourth Session

Session on Non-Ferrous Metals

Evaluation of a Single Shear Specimen for Sheet Material. W. W. Breindel, C. L. Seale, and R. L. Carlson, Battelle Memorial Institute.

A single, shear-type specimen has been investigated which appears to provide reproducible results. As a check on the general applicability of this type of specimen, annealed and cold-rolled type 304 stainless steel, type 2024-T3 aluminum alloy, and annealed type 6Al-4V titanium alloy materials have been tested. It appears that the single shear-type specimen can provide reproducible results by the proper selection of the critical dimensions—thickness, width, and length of shear path. Within a certain range of these variables, constant values of shear strengths have been obtained. This suggests that the value obtained is a constant for the material. Beyond the acceptable range of dimensions, buckling or tearing occurs.

A High Damping Magnesium Alloy for Missile Applications. G. F. Weissman and W. Babington, Bell Telephone Laboratories, Inc.

This paper describes the properties and some missile applications of a high-damping magnesium alloy, containing nominally 0.6 per cent zirconium with the balance magnesium. The mechanical and damping properties and casting characteristics of this alloy have been compared with those of conventional magnesium alloys, such as AZ81A and AZ91B.

The effect on damping properties of varying zirconium content, heat treatment, and machining has been established, and a comparison made of the alloy in both sand-cast and die-cast form. The use of this material in cast form for missile applications is discussed, demonstrating both the advantages and disadvantages of the alloy. Typical sand castings presently being employed in a missile guidance system are described and the results of vibration studies on these castings are reported.

The Effect of Atmosphere on Creep-Rupture Properties of a Nickel-Chromium-Aluminum Alloys. Paul Shahinian and M. R. Achter, U. S. Naval Research Laboratory.

The role of ductility in the effect of environment on creep and rupture properties was investigated employing a brittle 76 per cent nickel, 19 per cent chromium, and 4 per cent aluminum alloy. Creep-rupture tests were conducted primarily in air and in vacuum at 1300, 1500, and 1900 F.

It was found that at low temperatures and high stresses time-to-rupture was longer in vacuum than in air, but at high temperatures and low stresses it was longer in air. Generally conventional minimum creep rates were unaffected by environment. An unusual creep curve was obtained in air at the higher temperatures due apparently to oxidation, showing markedly greater than expected rupture time and ductility. The influence of atmosphere was related to crack formation and can be explained by previously advanced mechanisms.

Isochronous Stress-Strain Curves for Some Magnesium Alloys Showing the Effects of Varying Exposure Times on Their Creep Resistance. R. B. Clapper, The Dow Chemical Co.

The short-time creep resistance of some new high-temperature magnesium alloys were studied to show the effect of varying exposure times (5 sec to 3 hr) at test temperatures prior to testing. Both conventional-heating methods and rapid-heating methods were used in this investigation. The effects of heating rates on short-time creep resistance of these alloys are also discussed. The data are presented in the form of isochronous stress-strain curves to facilitate their use in design.

Young's Modulus of Magnesium Alloys as a Function of Temperature and Metallurgical Variables. R. W. Fenn, Jr., The Dow Chemical Co.

Accurate values of the relaxed Young's modulus, determined on several commercial magnesium alloys at elevated temperatures by static tension measurements, show significant variations in this important design property; differences are correlated with variations in alloy content, prior cold work, grain size, and heat treatment. These data are intended to provide information for design use in crippling and buckling calculations, and to show the degree of control which the metallurgist has over the relaxed Young's Modulus in these alloys.

Wednesday, June 25 4:00 p.m. Twenty-Sixth Session

Held simultaneously with the Twenty-Seventh Session

Committee Report Session

A-1 on Steel. W. F. Collins, Chairman.
B-3 on Corrosion of Non-Ferrous Metals and Alloys. K. G. Compton, Chairman.
B-6 on Die-Cast Metals and Alloys. W. Babington, Chairman.
D-1 on Paint, Varnish, Lacquer, and Related Products. W. T. Pearce, Chairman.
D-9 on Electrical Insulating Materials. H. K. Graves, Chairman.
E-4 on Metallography. L. L. Wyman, Chairman.
E-10 on Radioisotopes and Radiation Effects. C. E. Crompton, Chairman.
Joint Committee on Leather. J. R. Kanagy, Chairman.

Wednesday, June 25 4:00 p.m. Twenty-Seventh Session

Held simultaneously with the Twenty-Sixth Session

Committee Report Session

C-3 on Chemical-Resistant Mortars. Beaumont Thomas, Chairman.
C-9 on Concrete and Concrete Aggregates. W. H. Price, Chairman.
C-18 on Natural Building Stones. L. W. Currier, Chairman.
D-4 on Road and Paving Materials. K. B. Woods, Chairman.
E-3 on Chemical Analysis of Metals. Arba Thomas, Chairman.

Wednesday, June 25 4:30 p.m. Twenty-Eighth Session

Marburg Lecture

Adequacy of Raw Material Supplies for the Future. E. W. Pehrson, chief, Division of Foreign Activities, U. S. Bureau of Mines

The purpose of the Edgar Marburg Lecture is to have described at the annual meetings of the Society, by leaders in their respective fields, outstanding developments in the promotion of knowledge of engineering materials. Established as a means of emphasizing the importance of the function of the Society of promoting knowledge of materials, the Lecture honors and perpetuates the memory of Edgar Marburg, first Secretary of the Society, who placed its work on a firm foundation and through his development of the technical programs brought wide recognition to the Society as a forum for the discussion of properties and tests of engineering materials. [See abstract on p. 7.]

Thursday, June 26 9:30 a.m. Twenty-Ninth Session

Held simultaneously with the Thirtieth and Thirty-First Sessions

Session on Soils

Shear Strength and Elastic Properties of Soil-Cement Mixtures Under Triaxial Loading. G. G. Balmer, Portland Cement Assn.

The results of triaxial shear and deformation tests on two granular and two fine-grain soil-cement mixtures molded in the laboratory are presented.

The analyses of the data show that the coefficient of internal friction varies in a random manner with cement content and age for each soil and averages 0.95 for the granular soils and 0.73 for the fine-grain soils. The cohesive strength and the modulus of elasticity depend upon cement content, age, and soil type. The cohesion ranges from 35 to 530 psi, and the modulus ranges from 100,000 to 2,400,000 psi for granular soil and from 200,000 to 1,000,000 psi for fine-grain soils.

Soil Moisture Suction—Its Importance and Measurement. E. Penner, National Research Council.

The physicochemical and mechanical behavior of soil is conditioned largely by the moisture it contains. The soil below the water table is generally considered to be saturated and it is in the study of soils in this state that the greatest advance has been made in soil mechanics. More recently attempts have been made to deal with soils in the unsaturated state. For a complete understanding of the behavior of partially saturated soils it is necessary to consider fundamental properties of the soil water. One such property is soil moisture suction, commonly known also by terms such as moisture tension and negative pressure, which is the force with which the moisture is retained in the soil.

Whereas in saturated soils moisture flow is caused by a positive hydraulic pressure gradient, in unsaturated soil, at constant temperature, moisture moves as a result of a suction gradient. In the case of unsaturated flow the permeability coefficient in the Darcy equation decreases as the average suction in the soil moisture increases.

The methods used for determining soil moisture suction and unsaturated permeability have been largely developed in the field of soil science and are being used successfully in the engineering field. Both the apparatus and technique are described together with its use in soil engineering.

The Mechanical Behavior of Chemically Treated Granular Soils. R. L. Schiffman and C. R. Wilson, Rensselaer Polytechnic Institute.

This paper reports the results of a laboratory experimental research program on the mechanical behavior of chemically treated granular soils. The paper deals with the general concepts of mechanical action of addition polymer, the design of an experimental program, the results of the program, and interpretations of these results. The chemical used is commercially known as AM-9 and is manufactured by the American Cyanamid Co. The granular soils were carefully selected to have a control on the influence of mean grain size and range of grain size.

Measurement of Soil Pressure on a Laterally Loaded Pile. Hudson Matlock and E. A. Ripperger, The University of Texas.

Direct measurement of the pressure on a laterally loaded pile is impractical with instrumentation presently available. It is possible, however, to determine the pressure indirectly by measuring strains in the pile and converting these strains to bending moments from which the pressure is then obtained by double differentiation. To obtain satisfactory accuracy in the pressure determinations, a high degree of precision in the moment measurements is required. The order of accuracy required in the measurements, and special procedures for obtaining such accuracy are discussed. A set of sample results is presented to illustrate the effectiveness of the special techniques and procedures described.

Specific Gravity of Montmorillonite Clay Constituents. J. C. Shea, Department of the Army and the Air Force National Guard Bureau.

The paper describes a simple method that can detect qualitatively the presence of montmorillonite clays in soils and indicates possibilities for quantitative determinations.

Compressibility of Sands. J. E. Roberts and J. M. de Souza, Massachusetts Institute of Technology.

The paper presents the results of compression tests on sand which have been obtained as part of a basic study of the behavior of soils at high pressures sponsored by the Creole Petroleum Corporation. The test results show that at high pressures certain sands are more compressible than typical clays. Pressures up to 15,000 psi have been studied. At the higher pressures time effects become important. Examination of the individual sand grains shows that fracturing of the grains occurs during compression resulting in significant changes in grain size distribution.

The practical significance of the results to soil engineering and geological problems is discussed.

Thursday, June 26 9:30 a.m. Thirtieth Session

Held simultaneously with the Twenty-Ninth and Thirty-First Sessions

Session on Cement

Studies on Calcium Sulpho-Aluminate Admixtures for Expansive Cements. A. Klein and G. E. Troxell, University of California.

Sulfo-aluminate compounds of several compositions were produced and added to blends of ground blast-furnace slag and portland cement to study their effect in eliminating the undesirable shrinkage of concrete which normally occurs. Test variables included burning temperature, composition and fineness of the admixture, amount of replacement of cement by the admixture, composition of the portland cement, aging of the admixture before use, and curing conditions of test specimens. Results of physical tests indicate that only the admixtures high in free lime cause significant expansion for specimens soaked 7 days, that the admixtures high in free lime rapidly lose their effectiveness in causing expansion if exposed to the laboratory atmosphere, and that admixtures containing no free lime cause expansions about the equal of the corresponding portland cement during 7 days soaking, but show greater shrinkage on drying.

Variations in Portland Cement. Stanton Walker and D. L. Bloem, National Ready Mixed Concrete Assn.

Strength tests of 26 samples of cement from each of five widely separated sources, taken at two-week intervals over a period of a year, are reported. A sixth cement consisting of a blend of five brands from the Washington area was thoroughly mixed, separated into 26 parts and stored in sealed containers, for use as a standard of comparison. Also, sealed containers of the cements from outside sources were set aside for later use. Three principal series of tests were conducted at different times. The first involved standard mortar tests on all samples, the second concrete tests on selected samples, and the third concrete and mortar tests on selected samples. Significant variations in the strength-producing properties of different cements from the same source, as well as in those from different sources, were found. An excellent correlation between mortar and concrete strengths is shown by the data.

Aeration Cause of False Set in Portland Cement. W. C. Hansen, Universal Atlas Cement Co.

Data for two cements which developed false set upon aeration are presented. Extractions with water showed that aeration markedly reduced the rate at which these cements combined with calcium sulfate. Likewise, extractions in solutions of calcium chloride of clinkers ground without gypsum showed that aeration reduced the rate at which the clinker combined with calcium chloride. The conclusion is that aeration reduces the reactivity of $3CaO \cdot Al_2O_3$ toward calcium sulfate, which permits dehydrated gypsum to crystallized as gypsum and produces false set.

Thursday, June 26 9:30 a.m. Thirty-First Session

Held simultaneously with the Twenty-Ninth and Thirtieth Session

Symposium on Particle Size Measurement

The purpose of this Symposium on Particle Size Measurement, sponsored by Committee E-1 on Methods of Testing, is to bring up to date the earlier symposium held in 1941. The title of the 1941 symposium was New Methods for Particle Size Determination in the Sub-Sieve Range. Since that time and particularly during the war period, there were a number of new techniques developed, some of which involved new types of apparatus for particle size measurement. These developments in instrumentation and technology will be covered in this 1958 symposium.

Sieves, Sieving Methods and Microscopy

The Mechanics of Fine Sieving. K. T. Whitby, University of Minnesota.

From an experimental and analytical study, the laws governing the rate of sieving of four representative types of fine particulate material under nonsteady-state conditions have been determined. It has been found that the sieving rate curve can be divided into two distinct regions with a transition between. Region 1 exists when there are many particles much less than the mesh size still on the sieve. Region 2 exists when only near mesh size particles are passing the sieve. Equations relating such variables as particle size distribution, mesh size, density, sieve load, etc., and sieving rate have been developed for both regions. A limited extension of the nonsteady-state laws to steady-state sieving has also been made.

A Review of Sieve Standardization. L. V. Judson, National Bureau of Standards.

A review will be given of early proposals for a series of sieves and of early sieve specifications. The development and revisions of sieve specifications and the part taken by ASTM in this work will be traced. The attempts made by the International Standards Administration in the period fro m1930 to 1940 at international sieve standardization will be indicated and the progress made by the International Standards Organization Committee TC24 in really obtaining international sieve standardization will be reviewed. The beneficial effects on the U. S. specification obtained from international progress will be stated. The proposal to use glass beads as a means of sieve verification will be considered as well as other trends in future sieve standardization.

Application of Electroformed MicroMesh Sieves for the Precise Determination of Particle Size Distribution of Cracking Catalysts. H. W. Daeschner, E. E. Seibert, and E. D. Peters, Shell Development Co.

Woven wire sieves present a variety of problems to the petroleum refiner who tries to use them for the determination of particle size distribution of cracking catalysts. Not only are the sieves limited in the lower range to 44 microns, but they are inherently unreliable. The strongly entrenched popularity of the sieving procedure, resulting from its simplicity, prompted us to investigate a new product made by electroforming nickel in meshes of precise square openings ranging from 15 to 105 microns. A satisfactory sieve has been developed and details of procedures for use established. These micromesh sieves are recommended as a primary standard for testing size distribution of cracking catalysts because of their highly precise openings, which can be reliably measured with a microscope, and because they are available in the range of interest.

Oral Presentation on the Fluid Cracking Catalysts. L. L. Mittelman, Tidewater Oil Co.

The Stanford Research Institute Particle Bank. R. D. Cadle and W. C. Thuman, Stanford Research Institute.

Early in 1956 Stanford Research Institute established a Particle Bank to serve as a depository for carefully characterized samples of powders and to make them available for a nominal handling fee to any investigator who might need them. This paper describes the response to the original questionnaires that were sent out prior to the establishment of the bank, types of samples which have been submitted, and numbers and types of requests for samples which have been received. Comparative data for a number of samples are discussed. Judging from the activity of the bank, it is filling a real need in the fine particle field.

(Continued in Thirty-Third and Thirty-Ninth Sessions)

Thursday, June 26 11:15 a.m. Thirty-Second Session

Committee Report Session

C-8 on Refractories. J. J. Hazel, Chairman.
C-12 on Mortars for Unit Masonry. R. E. Copeland, Chairman.
C-20 on Acoustical Materials. H. A. Leedy, Chairman.
C-21 on Ceramic Whitewares and Related Products. M. D. Burdick, Chairman.
C-22 on Porcelain Enamel. W. N. Harrison, Chairman.
D-5 on Coal and Coke. O. W. Rees, Chairman.
D-14 on Adhesives. R. F. Blomquist, Chairman.
D-20 on Plastics. F. W. Reinhart, Chairman.

Thursday, June 26 12:00 noon

Petroleum Industry Luncheon

Sponsored by Committee D-2 on Petroleum Products and Lubricants.

Speaker: Prof. Hoyt C. Hottell, Department of Chemical Engineering, Massachusetts Institute of Technology

Thursday, June 26 12:00 noon

Instrument and Apparatus Industry Luncheon

Sponsored by Committee E-1 on Methods of Testing.

Speaker: Dr. A. V. Astin, Director, National Bureau of Standards.

Thursday, June 26 2:00 p.m. Thirty-Third Session

Held simultaneously with the Thirty-Fourth Session

Symposium on Particle Size Measurement (Continued)

Sedimentation Methods

Recent Developments in the Hydrometer Method as Applied to Soils. E. E. Bauer, University of Illinois.

The ASTM method of test for grain-size analysis of soils (ASTM Method: D422) was extensively revised and rewritten in 1954. Provision was made in hydrometer specification (ASTM Specification: E 100) for two hydrometers for reading soil suspension densities. Hydrometer size requirements were made sufficiently rigid to permit interchange of instruments. New air-dispersion equipment was included in addition to the mechanical mixer device. The dispersing agent was changed from sodium silicate to sodium hexametaphosphate, the latter being a much more effective agent. Calculations were greatly simplified, with most of the correction factors of the original method eliminated. Several tables of values were included for use in computing diameter-of-particle and percentage values, using an ordinary 10-in. slide rule.

Sedimentation Procedures for Determining Particle Size Distribution. W. F. Sullivan and A. E. Jacobsen, National Lead Co.

The theory underlying the application of sedimentation procedures for particle size distribution is presented. Modifications of the theory to satisfy the several types of sedimentation techniques are described. Consideration is given to the various experimental techniques, particularly to the advantages and disadvantages of each. Experimental results are presented for the entire subsieve range.

A Photoelectric Sedimentation Method for Particle Size Determination in the Sub-Sieve Range. H. R. Harner and J. R. Musgrave, The Eagle-Picher Co.

This method consists essentially of measuring the light absorbed by a suspension of the particles in a liquid medium; increments of light absorption are measured as the particles settle in the medium. A photoelectric cell is used to measure the light absorption. The apparatus is simple and comprises a stable light system, a cell (for containing the suspension), a photoelectric cell, and a microammeter. Calculations are based on Stokes' law with modifications to compensate for variations with very fine particles. Comparison with other methods shows good agreement. While not absolute, the method is reasonably accurate and reproducible; it has the distinct advantage of speed and simplicity and gives a complete size distribution. The elapsed time required for a determination is approximately one hour. A wide variety of materials has been successfully analyzed by this method.

Centrifuge Sedimentation Size Analysis of Membrane Filter Collected Samples of Airborne Dusts. K. T. Whitby, A. B. Algren, and J. C. Annis, University of Minnesota.

The application of the rapid, general-purpose centrifuge sedimentation method developed at the University of Minnesota to the size analysis of fine powders has been previously described.

Through the development of special fine bore capillary centrifuge tubes this method has been extended to the size analysis of fractional milligram quantities of airborne dusts collected on 47-mm size membrane filters. Evaluation of this method against light and electron microscope data and its extensive use in an airborne dust survey have shown that it is a practical and convenient tool for the size analysis of airborne dusts. This paper describes the application of this method to airborne dusts and its evaluation against light and electron microscope size analysis data. Its application to very fine, dilute suspensions of particles, that is, particles in crankcase oils, is also described.

A Liquid Sedimentation Method for Particle Size Distributions. L. M. Cartwright and R. Q. Gregg, Phillips Petroleum Co.

Measurement of particle size distributions in the subsieve range from 0.5 to 100 microns is a very difficult and laborious task using microscopic methods. In the method described here a specially-shaped, glass tube is nearly filled with a suitable sedimentation liquid. The sample is dispersed in a second liquid which is miscible with the sedimentation liquid but of slightly lower density. A thin layer of this dispersion is then floated onto the surface of the sedimentation liquid, with minimum mixing, so that all of the particles start essentially at the top of the sedimentation tube. Thus, as the sedimentation progresses, the particles become classified according to size, the larger ones reaching the bottom first. After the larger particles have settled to the bottom under gravity, the sedimentation tube is centrifuged to reduce the time required for the smaller particles to reach the bottom. By measuring the volume of particles accumulated as a function of time, the equivalent spherical size distribution of the sample may be computed from formulae based upon Stokes' law.

Determination of Particle-Size Distribution by Examining Gravitational and Centrifugal Sedimentation According to the Pipet Method and with Divers. Soren Berg, Porcelaensfabrik Denmark.

By examining gravitational sedimentation a new pipette apparatus for the determination of particle size distribution, especially of coarse products, may be applied in the particle-size range from 500 μ to 0.5 μ and the diver method from 25 μ to 0.2 μ (even for monodisperse products). By examining centrifugal sedimentation in conoidal vessels as well, the particle-size range 0.5 μ to 0.005 μ may be investigated.

(Continued in Thirty-Ninth Session)

Thursday, June 26 3:00 p.m. Thirty-Fourth Session

Held simultaneously with the Thirty-Third Session

Symposium on Paper and Paper Products

In recent months increasing emphasis has been placed on the concept of creativity in all branches of science and technology. While paper represents one of the oldest products of fiber technology, it has been a unique material in that it has been adaptable to the broadening needs of man over many generations. In the last few years the advances in this field have been especially rapid and startling. These have included innovations in the papermaking process, in fiber composition, and in after-treatments of the finished sheet. This first ASTM syposium on new developments in paper will cover a few of the outstanding accomplishments with special consideration of the methods required for the testing of these new products. It will show that there is no lack of creativeness among those people to whom is entrusted responsibility for the development and application of paper materials.

Some Historical Developments in Paper Testing. W. R. Willets and F. R. Marchetti, Titanium Pigment Corp.

Some aspects of paper testing are undoubtedly as old as papermaking itself. Traditionally paper has been merchandised on the basis of dimensions and weight so obviously paper tests for such properties were used. By the end of the nineteenth century paper testing was already on firm ground as shown by the publication of Herzberg's comprehensive treatise in 1888. The "TAPPI Bibliography, 1900–1928" devotes over fifty pages to paper testing with many citations in the 19th century.

Such references show that methods for many properties have been in use for years, although these have been improved and modified to meet changing conditions brought about by new raw materials, new paper grades, and new end uses. Paper testing techniques have kept abreast of new developments in paper.

New Developments in the Internal Bonding of Paper. K. W. Britt and J. W. Eastes, Scott Paper Co.

Most paper is made from natural cellulose fibers possessing a unique interfiber bonding mechanism that accounts for most of the strength of the product. With all its remarkable properties and great utility, this bond has serious deficiencies, such as lack of wet strength and lack of resistance to repeated flexing. For these and other reasons there has been a search for additives to increase or modify the interfiber bonding in paper. The introduction of wet strength resins some years ago and the present interest in numerous synthetic polymers as bonding agents indicate important technical progress in interfiber bonding. The use of synthetic fibers in which bonding must be supplied artificially is an additional reason for research in this field.

Non-Woven Fabrics and Synthetic Fiber Papers: Technology and End Uses. J. T. Taylor and P. J. McLaughlin, Rohm & Haas Co.

Recent advances in textile and paper technology have resulted in products from these two industries whose end uses are closely parallel or substantially identical. This paper summarizes current production and test methods for nonwoven fabrics and (so far as available) similar data for synthetic fiber papers, with emphasis on the role of the bonding agent. Fabric-like products frequently require certain properties, such as dry-clean fastness, wash-fastness, and hand; paper-like materials are usually tested for dimensional stability, toughness, and tear strength. There is an extensive area of overlap where similar test methods are applied to structures produced either by textile or papermaking techniques.

(Continued in the Thirty-Sixth Session)

Thursday, June 26 4:30 p.m. Thirty-Fifth Session

Committee Report Session

B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts. E. I. Shobert II, Chairman.

D-17 on Naval Stores. V. E. Grotlisch, Chairman.

D-21 on Wax Polishes and Related Material. W. W. Walton, Chairman.

D-22 on Methods of Atmospheric Sampling and Analysis. L. C. McCabe, Chairman.

D-23 on Cellulose and Cellulose Derivatives. F. A. Simmonds, Chairman.

D-24 on Carbon Black. S. R. Doner, Chairman.

E-1 on Methods of Testing. A. C. Webber, Acting Chairman.

E-2 on Emission Spectroscopy. D. L. Fry, Chairman.

E-7 on Nondestructive Testing. J. H. Bly, Chairman.

E-13 on Absorption Spectroscopy. E. J. Rosenbaum, Chairman.

Thursday, June 26 7:30 p.m. Thirty-Sixth Session

Held simultaneously with the Thirty-Seventh and Thirty-Eighth Sessions

Symposium on Paper and Paper Products (Continued)

Report of Committee D-6 on Paper and Paper Products. R. H. Carter, Chairman.

Symposium on Paper and Paper Products

Testing of Synthetic Fiber Papers. F. H. Koontz and J. K. Owens, E. I. du Pont de Nemours & Co., Inc.

The utilization of synthetic fibers in papermaking has necessitated the modification of several existing ASTM and TAPPI test methods, and the incorporation of a number of new methods to characterize these paper-like products. This paper will present a description of these test methods and will include a discussion of the data obtained using them. The need for new or modified methods is demonstrated by the very high tear strength and wet strength, extremely high fold endurance, strain at failure, toughness, dimensional stability, chemical resistance, and electrical properties of these paper-like products.

Clupak—A Revolutionary High Stretch Paper—Its Manufacture and Performance. R. J. Diaz, West Virginia Pulp and Paper Co.

Knit Paper—Its Uses as a Utilitarian Textile. R. H. Marks, Enterprise Incorporated.

Paper, which has been used in myriad forms, is soon to be joined in many commercial applications by being knit to form meshes and materials of many textures of varied appearance and for a multitude of uses. Knit paper mesh possesses unusual strength, and has the characteristic of stretch which makes it adaptable to many fields. It has been formed into bags, baling material, reinforcement for plastics, and even into clothing such as suits and dresses. The paper clothing, which is manufactured from knit paper mesh, can be washed or dry cleaned, and therefore becomes competitive to other materials of a similar nature. The future for knit paper mesh materials will be enhanced by the research in pulp formulations for paper production for this new end use.

Thursday, June 26 8:00 p.m. Thirty-Seventh Session

Held simultaneously with the Thirty-Sixth and Thirty-Eighth Sessions

Symposium on Applications of Soil Testing in Highway Design and Construction

In recent years the expansion of the highway program has placed increased emphasis on the use of soil testing procedures both in design and construction. To present new developments in this field, Committee D-18 on Soils for Engineering Purposes has arranged a symposium of 10 papers dealing with this phase of activity.

Examples of Highway Soil Engineering. E. S. Barber, University of Maryland.

Use of soil engineering in highways is illustrated by a variety of examples taken from experience on turnpike, interstate, and Guatemalan highways.

Various screening tests to supplement routine classification are suggested, as well as methods of indicating mica content and degree of nonplasticity.

Examples are presented illustrating weathering, intrusion, special considerations in compaction and pavement design, sand drains for slopes and acceleration of swelling, secondary consolidation, bearing capacity on slopes, stability of fissured clay, fills on soft soil, and abutment displacement.

Problems of management and education are considered. Relation of soil to other materials is illustrated by grading requirements, shrinkage of asphalt, and swelling of masonry.

Subsurface Exploration with Drilling Machines, Power Augers, and Earth Resistivity. D. G. Shurig and E. J. Yoder, Purdue University.

The selection of procedures and techniques best suited for exploring highway cuts and borrow pits is a problem confronting engineers. Methods available include drilling machines, augers, seismic and resistivity methods, air photo interpretation, and others.

This paper presents data pertaining to the use of power augers and earth-resistivity units to supplement drilling machines for highway exploration. Data taken during the exploration program of the north-eastern extension of the Pennsylvania Turnpike system are the basis of the study. Data taken in cut areas, where all three machines were used side by side, were analyzed and compared to the true subsurface conditions as revealed by the exposed cut slopes.

The Soil Exploration and Mapping Cooperative Project in Illinois. Nicholas Chryssafopoulos, University of Illinois.

The Soil Exploration and Mapping Project of the Illinois Cooperative Highway Research Program has, as its ultimate goal, the preparation of a Soils Manual for the State of Illinois. The project was started as a cooperative venture of the Illinois Division of Highways and the University of Illinois Engineering Experiment Station. In 1952 the Bureau of Public Roads joined the project as cosponsor. Work, at present, consists of the preparation of soils maps for use by the Division of Highways in planning the relocation and improvement of existing roads, and the location of new highways. Parallel to mapping, soil sampling and testing are also performed to determine the engineering properties of the soil types mapped.

Research is also being done on the relation of soil properties and of the influence of subgrade soils on highway pavement performance.

Investigation of Banded Sediments Along St. Lawrence-North Shore in Quebec. R. W. J. Pryer, North Shore and Labrador Railroad, and K. B. Woods, Purdue University.

The St. Lawrence-North Shore section of the Province of Quebec is a narrow coastal plain, only a few miles in width, which lies along the southern boundary of the Labrador Peninsula. This low coastal plain, is made up of stratified sands, silts, and silty clays of marine and glacio-fluvial origin.

Some failures in cut slopes were encountered during and after construction of the Quebec, North Shore, and Labrador Railroad, and as a result, a large-scale program of exploration and testing was initiated in the fall of 1955 and the spring of 1956.

This paper presents a summary of the program of explorations, covering a total of 11,000 ft. of boring and sampling at 126 different locations. Representative samples were obtained by split-barrel samplers and by thin-wall, open-drive samplers. A total of 443 samples were obtained in this manner for identification and classification purposes, and an additional 240 thin-wall Shelby tube samples were obtained for unconfined compression tests and to provide information on stratification. *In situ* strength tests were also obtained by using a rotary vane in a few locations.

The Growth of Soil Testing in South Europe and the Middle East. T. J. McNeil, Soiltest, Inc.

An analysis and personal observations by the author on the growth and interest in testing laboratories in fourteen countries in southern Europe and the Middle East is presented. There is an ever-widening interest in the establishment of new laboratories throughout the world. The author visited these fourteen countries during a recent two month period.

(Continued in Fourty-Second Session)

Thursday, June 26 8:00 p.m. Thirty-Eighth Session

Held simultaneously with the Thirty-Sixth and Thirty-Seventh Sessions

Symposium on Radioactivity in Industrial Water and Industrial Waste Water

Report of Committee D-19 on Industrial Water. Max Hecht, Chairman.

Symposium on Radioactivity in Industrial Water and Industrial Waste Water

The advent of nuclear power has brought new problems to the field of water technology. Committee D-19 on Industrial Water keenly recognizes the importance and impact of nuclear developments on water analysis methods and is sponsoring a symposium on this subject, the program for which appears below.

In this symposium problems in the reactor plant proper will be discussed, the associated waste water processing and control methods described, and methods of analyses for radionuclides in industrial water and industrial waste water presented, including radiation hazards. The effect of nuclear operations on the environment and analysis of samples pertaining thereto will be included.

This is a timely symposium in view of the ultimate necessity of providing ASTM standard methods of water analysis for this growing field.

Radioactivity and Purity Control of APPR Primary Water. A. L. Medin, Alco Products, Inc.

Primary system purification for pressurized water reactors is needed to satisfy both conventional and nuclear requirements. Included in these reasons is the need to minimize deposition on primary system components.

The potential buildup of radioactivity on primary system piping and components could seriously complicate maintenance. This radioactivity buildup results from deposition, atom exchange or both. The principal nuclide which contributes to the maintenance problem is the 5.3 yr half-live Co^{60} which results from the presence of cobalt impurities in austenitic stainless steel. A generalized curve for this buildup is given.

A discussion of the effectiveness of the purification system in reducing this buildup is given. The possible ineffectiveness of purification in reducing this buildup may result because of poor location of the purification piping.

The program of investigating activity buildup at the Army Package Power Reactor is discussed. Preliminary results on water samples obtained during operation of this reactor are given. Results of primary system purification, including demineralizer decontamination factors, are also given.

Radioactive Waste Processing and Control at the Shippingport Atomic Power Station. S. F. Whirl and J. A. Tash, Duquesne Light Co.

The liquid, solid, and gaseous radioactive wastes at the Shippingport Atomic Power Station are collected, processed, and disposed of separately. The disposal processes include concentration and storage, natural decay, and dilution and dispersion and are all carried out in a central waste disposal area. Ion-exchange, evaporation, and incineration are used to effect volume reduction.

A brief description of the processes is followed by details of sampling and analyses necessary to control operation and safe disposal. Details of methods and apparatus for tritium and gas activity are given.

Test Methods for Radiation Hazards in Industrial Water. C. J. Munter, Hagan Chemicals & Controls, Inc.

Standards for allowable radiation hazards in water have been set, but the testing for radioactivity in water presents problems. Variations in sampling, preparation of samples, and counting procedures are common. Some of these methods are reviewed, the possibilities of standardization of methods and improvements in methods are considered.

Analysis for Radionuclides in Aqueous Wastes from an "Atomic" Plant. B. Kahn, Massachusetts Institute of Technology, D. W. Moeller, U. S. Public Health Service, T. H. Handley and S. A. Reynolds, Oak Ridge National Laboratory.

Waste water from a plant operating reactors and processing spent fuel contains many radionuclides, formed both by neutron capture and by fission. Methods of analysis and typical findings are reported for a variety of aqueous samples, including: reactor coolant, water from settling basins and "lagoons," seepage from lagoons, underground water, water from a small lake, and from a river. Analysis by radiochemical methods is described, and considerable attention is given to measurement of gamma-emitters by scintillation spectrometry, a versatile technique for identification and quantitative determination. Most of the types of materials to be described are characterized by moderate levels of radioactivity. A brief description is given of techniques for measuring extremely small concentrations of radioelements.

The Analysis of Environmental Samples for Radionuclides. D. L. Reid, General Electric Co.

The production, processing, or use of radioactive materials presents problems relative to their controlled or uncontrolled release to the internal or external plant environs. One such problem is associated with quantitatively defining the material released. The methods presented for vegetation analysis develop the major analytical approaches available with the present alpha, beta, and gamma instrumentation. The maximum permissible concentrations are related to the analytical sensitivity and complexity of radiochemical methods and equipment.

Summation. J. M. Seamon, National Aluminate Corp.

Friday, June 27 9:30 a.m. Thirty-Ninth Session

Symposium on Particle Size Measurement (Continued)

Other Particle Size Methods and Correlations

A Discussion of the Recommended Practice of Reporting Particle Size Characteristics of Pigments (ASTM Method D 1366 – 55 T). J. H. Calbeck, American Zinc Sales Co.

The ASTM Recommended Practice of Reporting Particle Size Characteristics of Pigments (D 1366) was published as tentative in 1955. The present paper outlines the need for specifications of this type, and presents more detailed instructions for making use of this recommended practice than are given in the recommended practice itself. It also includes a discussion of a number of methods for reporting particle size characteristics that have been suggested during the five years of committee work. Although many of these recommendations were not incorporated in the recommended practice, they are of considerable interest and may be considered for incorporation when the recommended practice is revised.

The Determination of Particle Size by Adsorption Methods. R. J. Fries, Mellon Institute of Industrial Research.

This paper is essentially a survey of the methods and apparatus available for determining the particle size and surface area of finely divided solids by the adsorption of gases and liquids. A general discussion of the basis and applicability of the method is presented. The evaluation of the surface area from gas adsorption data is then considered, followed by a detailed discussion of the experimental techniques and apparatus used for gas adsorption studies. The methods of determining surface areas by adsorption from solution and heat of wetting measurements are then briefly examined. Finally, data from the literature are presented comparing the results of adsorption methods of particle size determination with several other methods, particularly electron microscopy.

Use and Limitations of the Blaine Fineness Tester. S. S. Ober and K. J. Frederick, Abbott Laboratories.

The Blaine Fineness Tester, specifically, and air permeability methods in general, are shown to be vastly underrated in scope of application. This paper deals with the calibration, reproducibility, significance of the Kozeny-Carmen equation, and necessary correction factors required for general application. Supporting and comparative data (with nitrogen adsorption measurements) are also cited. Special emphasis is placed on surface area as opposed to the misuse of the technique as a particle sizer. Key references are cited.

Three-Dimensional Electronic Sizing of Subsieve Particles at 6000 Per Second. R. H. Berg, Process Control Services Co.

A basic, new principle of particle content and size analysis is described, with a review of principal theoretical points. Sizes ranging from below 0.6 micron to over 200 microns are covered, with unprecedented versatility, speed, and accuracy. A suspension of particles in conductive liquid flows through an aperture with simultaneous flow of electric current, resulting in a series of electrical pulses, each pulse proportional in size to the volume of the particle causing it. The pulses are amplified, scaled, and counted to provide direct data for plotting cumulative particle frequency against particle size. Potentials and limitations are discussed, and methods of calibration, sample preparation, and data reduction are emphasized, with specific comparisons of results with those of other methods.

Particle Size Determination on Tungsten Metal Powders in the 1 to 10 Micron Range. W. H. Bleeker, Allegheny Ludlum Steel Corp.

Subcommittee IIB of Committee B-9 was formed for the purpose of examining the need for specifications and test procedures on refractory metal powders. Agreement was unanimous from the first that the need for a reliable procedure for determining particle size and size distribution on tungsten metal powders was urgent. Manufacturers and users of tungsten powder participated in a series of round robin determinations for the following methods: (*a*) Fisher Sub-Sieve Sizer, (*b*) turbidimetric methods, (*c*) microscopic methods, and (*d*) apparent density.

Subsequently, it was found that the Fisher instrument alone was capable of reproducible results, and a Proposed Tentative Specification is now in ballot. Both the turbidimetric and the microscopic-count methods are still under investigation, and the Scott density method is being balloted. Up to the present, we have found no method for determining size distribution with any reasonable degree of reproducibility, but there are one or two interesting possibilities.

Friday, June 27 — 12:30 p.m. — Fortieth Session

Held simultaneously with the Forty-First Session

Committee Report Session

A-3 on Cast Iron. D. E. Krause, Chairman.
D-2 on Petroleum Products and Lubricants. H. M. Smith, Chairman.
D-3 on Gaseous Fuels. F. E. Vandaveer, Acting Chairman.
D-10 on Shipping Containers. G. E. Falkenau, Chairman.
D-11 on Rubber and Rubber-Like Materials. Simon Collier, Chairman.
D-12 on Soaps and Other Detergents. J. C. Harris, Chairman.
D-16 on Industrial Aromatic Hydrocarbons and Related Materials. D. F. Gould, Chairman.
F-2 on Flexible Barrier Mateirals. Clifton Sutton, Chairman.
D-20 on Plastics. F. W. Reinhart, Chairman.

Friday, June 27 — 12:30 p.m. — Forty-First Session

Held simultaneously with the Fortieth Session

Committee Report Session

C-1 on Cement. R. R. Litehiser, Chairman.
C-11 on Gypsum. G. W. Josephson, Chairman.
C-13 on Concrete Pipe. R. R. Litehiser, Chairman.
C-14 on Glass and Glass Products. L. G. Ghering, Chairman.
C-15 on Manufactured Masonry Units. J. W. Whittemore, Chairman.
C-16 on Thermal Insulating Materials. W. L. Gantz, Chairman.
C-19 on Structural Sandwich Constructions. George Gerard, Chairman.
D-8 on Bituminous Waterproofing and Roofing Materials. H. R. Snoke, Chairman.

Friday, June 27 — 2:00 p.m. — Forty-Second Session

Symposium on Applications of Soil Testing in Highway Design and Construction (Continued)

Report of Committee D-18 on Soils for Engineering Purposes. E. J. Kilcawley, Chairman.

Methods of Compacting Granular Soils. E. J. Felt, Portland Cement Assn.

Methods of soil-compaction control based upon the standard moisture-density test, which are appropriate for cohesive-type soils, are not necessarily suitable for cohesionless soils. To alleviate this problem a section committee has been established to develop methods of test for determining the maximum and minimum densities of granular soils.

This paper presents density data for several cohesionless soils obtained by members of the committee using various methods of compaction. Most of the methods for determining maximum density involved vibration rather than dynamic rammer compaction as used in the test for Moisture-Density Relations of Soils (ASTM Method: D 698).

Ohio's Typical Moisture-Density Curves. J. G. Joslin, Ohio State Highway Testing Laboratory.

The development of Ohio's typical moisture-density curves began when it was noticed that for similar soil types the curves plotted from the moisture-density test assumed characteristic shapes regardless of the source of supply. Similar soil types were grouped according to a 5 lb weight interval and a 2 per cent moisture increment. This information was tabulated for 12 yr and the dry weight, wet weight, and penetration resistance data were averaged to determine typical values. Three sets of typical curves were developed during this period. A typical moisture-density circular slide rule was developed to facilitate the use of these typical curves. The use of the typical curves and circular slide rule are discussed in performing the field-embankment-compaction test and the testing of soil-embankment samples.

Soil Classification Scheme Based on Compaction Tests. J. L. McRae, U. S. Army Engineer Waterways Experiment Station.

This paper shows that a semilog plot of optimum dry density *versus* compactive effort in energy per unit volume gives essentially a straight line relationship for compactive efforts between standard and modified methods of the Am. Assn. of State Highway Officials. The slope of this line varies with the plasticity and other related properties, the slope becoming steeper as the plasticity increases and the soil becomes more difficult to compact.

Laboratory compaction tests conducted at three compactive efforts and plotted as described above could be used as a basis for a classification scheme. Such data could also be used for guidance in establishing compaction requirements for different soils and for predetermining the degree of compaction necessary to achieve a desired amount of compaction in the field.

Laboratory Shear Tests on Varved Clays and Their Application to Design. R. E. Machol, University of Connecticut.

At the present time and in the near future a large number of highway earth fills and earth filled bridge approaches will be constructed in the State of Connecticut. A great many of these fills will be constructed in the Connecticut Valley on relatively deep deposits of varved clay, and will require a great deal of control while being placed. Because of this situation, a joint research project was initiated between the Connecticut State Highway Department and the University of Connecticut. The laboratory data from two phases of this project are presented in this paper. The first phase consists of the determination of the shearing strength of varved clay under various degrees of consolidation using triaxial apparatus. The second phase compares the shearing strength of varved clays as determined from field vane, laboratory miniature vane, and unconfined compression tests.

The Value of Soil Test Data in Local and Regional Road Planning. Martin Ekse, University of Washington.

The paper relates several ways in which data and results of the evaluation study may be used: to extend findings of road tests to local conditions of soil and climate, to enable County engineers to make better selective use of their soils in road construction, to establish a formula for determination of comparative needs in making allocations of highway funds, to establish average construction requirements for a state, as an aid in setting up a highway tax structure, and discusses the correlation between pedological soil classification and population distribution, which is useful in predicting highway needs.

Actions on Standards

The Administrative Committee on Standards is empowered to pass on proposed new tentatives and revisions of existing tentatives and tentative revisions of standards offered between Annual Meetings of the Society. On **February 28, 1958** the Standards Committee took these actions:

ELECTRICAL INSULATING MATERIALS

Tentative Method of Test by Visual Examination of Used Electrical Oils in the Field (D 1524 – 58 T)

New Tentative.—This method of visual examination applies to used mineral oils of petroleum origin used in transformers, oil circuit breakers, and other electrical apparatus as an insulating or cooling medium or both. The method is useful for visual determination of cloudiness, indicative of moisture or sludge; particles of insulation, products of metal corrosion; and other undesirable material. It is expected that use of this method in the field may make it possible to extend the period between laboratory tests.

Tentative Methods of Testing Nonrigid Polyvinyl Tubing (D 876 – 54 T)

Revision.—For satisfactory use of the methods, changes were made in the tests for resistance to heat aging, brittleness, dielectric strength at high humidity, and stress relief.

Tentative Methods for Testing Pressure-Sensitive Adhesive Coated Tapes Used for Electrical Insulation (D 1000 – 55 T)

Revision.—In order to make the method adequate for present usage, sections were added on bond separation, and shear strength after solvent immersion.

Standard Method of Sampling Electrical Insulating Oils (D 923 – 49)

Tentative Revision.—Method D 923 has been applicable only to the low-viscosity oil used in transformers and circuit breakers. The tentative revision would make the method applicable to sampling of the viscous oils used in cables insulated with oil impregnated paper.

PLASTICS

Tentative Specifications for Biaxially Oriented Styrene Plastic Sheet (D 1463 – 58 T)

New Tentative.—Oriented styrene sheet has assumed commercial importance and specifications are needed for establishing quality standards. Two types of sheet are covered—a general purpose sheet made from polystyrene, and a sheet made from a styrene-acrylonitrile copolymer, both with or without the addition of colorants and small amounts of lubricants.

Tentative Specifications for Polyester Compounds (D 1201 – 52 T)

Revision.—A new Type 5 has been added with a specific gravity of 1.95 min and 2.10 max; flexural strength, min, psi—12,000; modulus of elasticity in flexure, min, psi—2,000,000; impact strength (Izod) min, ft lb per in. of notch—6; arc resistance, min, sec—130, water absorption, 24 hr, per cent max—0.15.

Standard Specifications for Urea-Formaldehyde Molding Compounds (D 705 – 55)

Revision and Reversion to Tentative.—The classification terminology has been changed as well as the electrical requirements.

RUBBER AND RUBBER-LIKE MATERIALS

Tentative Specification for Synthetic Rubber Heat-Resisting, Moisture-Resisting Insulation for Wire and Cable (D 1520 – 58 T)

Tentative Specification for Synthetic Rubber, Moisture Resisting, Insulation for Wire and Cable (D 1521 – 58 T)

New Tentatives.—These specifications cover a vulcanized rubber insulating compound for electrical wires and cables, the rubber hydrocarbon of which shall consist substantially of synthetic rubber. The type of insulation covered by Specification D 1520 is considered suitable for continuous operation at conductor temperatures up to 75 C in dry locations and 60 C in wet locations, and operating voltages not exceeding 5000. The type of insulation covered by Specification D 1521 is considered suitable for continuous operation at conductor temperatures up to 60 C and operating voltages not exceeding 5000 v. The insulation covered by these specifications has low-temperature limitations.

Tentative Method of Test for Melting Range of Rubber Chemicals (D 1519 – 58 T)

New Tentative.—This method has resulted from an extensive study of the melting point of impure chemicals. It describes the procedure for determining the melting range of commercial rubber processing chemicals such as accelerators and antioxidants. The method is capable of providing melting range control within a single laboratory. Because of lack of interlaboratory reproducibility, the method is not recommended as a basis for absolute definition of quality except in cases where the interlaboratory reproducibility is considered to be sufficient for this purpose.

Tentative Methods of Testing Rubber and Thermoplastic Insulated Wire and Cable (D 470 – 56 T)

Revision.—A method for measuring corona level is provided in order to establish minimum values in the Specification for Construction of Rubber Insulated Wire and Cable (D 1350).

Tentative Method of Test for Indentation of Rubber by Means of a Durometer (D 676 – 55 T)

Revision.—A note was added to Section 2(*c*) on Indicating Device, discussing a change that was made in 1955 in the length of the indentor extension of the type A durometer which give readings more in line with the ISO standard hardness.

Tentative Specifications for Elastomer Compounds for Automotive Applications (D 735 – 57 T)

Revision.—The temperatures were changed to conform with the standard temperatures in the Recommended Practice for Standard Test Temperatures for Rubber and Rubber-Like Materials (D 1349), and other sections of the specification were clarified.

Tentative Specifications and Methods of Test for Latex Foam Rubbers (D 1055 – 56 T)

Tentative Specifications and Methods of Test for Sponge and Expanded Cellular Rubber Products (D 1056 – 56 T)

Revision.—The suggested dimensional tolerances appearing in the appendix have been made a part of the specifications.

Tentative Method of Measuring Low-Temperature Stiffening of Rubber and Rubber-Like Materials by the Gehman Torsional Apparatus (D 1053 – 54 T)

Revision.—This method has been completely rewritten in the interests of clarification and bringing it up to date.

Tentative Method of Test for Evaluating Low-Temperature Characteristics of Rubber and Rubber-Like Materials by a Temperature Retraction Procedure (D 1329 – 54 T)

Revision.—The change consists of a clarification of Section 6 on Testing Elongation.

Tentative Recommended Practice for Standard Test Temperature for Rubber and Rubber-Like Materials (D 1349 – 54 T)

Revision.—Two additional aging temperatures have been added to provide for certain Government specifications.

Tentative Specifications for Construction of Rubber Insulated Wire and Cable (D 1350 – 56 T)

Revision.—Minimum corona level values have been added and several sections have been brought up to date.

Tentative Recommended Practice for Description of Types of Styrene-Butadiene Rubbers (SBR) (D 1419 – 56 T)

Tentative Recommended Practice for Description of Types of Styrene-Butadiene (SBR) and Butadiene Rubber (BR) Latices (D 1420 – 56 T)

Revision.—Permanent numbers for new SBR rubbers and SBR latices, whose assignment has been announced currently, have been added to the respective recommended practice.

SAMA Polls Executives

Reveals Need for Better Research Reports

The Scientific Apparatus Manufacturers Assn. has conducted a survey of top executives in 500 companies to investigate the value of research reports. Based on a return of 18 per cent, only one in seven top management men felt that present research reports were satisfactory.

The three most mentioned recommendations to improve research reports and to make them more helpful to management were: (1) include more meaningful conclusions; (2) place more stress on the implications of the results; and (3) pay more attention to the dollar and marketing value of findings.

NEW ASTM PUBLICATIONS

Symposium on Nondestructive Tests in the Nuclear Energy Field

This symposium evolved from the meetings of an informal committee within the Atomic Energy Commission contractors dealing with the general subject of nondestructive testing. These included representatives from the National Laboratories, the Plutonium Plants, and several other AEC contractors. Considerable development of ultrasonic and eddy current test procedures had been accomplished, and in addition, work had been done on several other types of nondestructive testing. Applications had been made in the inspection of castings, tubing, of unclad fuel element components, and clad fuel elements.

As the information developed in the committee meetings was in the process of being declassified, there was a desire for a national meeting where papers on the subject could be presented. The objectives of the proposed symposium were to disseminate fifteen years of research and development in the nondestructive testing applications in the nuclear field and to reach people interested in nuclear and industrial applications. The symposium was held in Chicago, Ill., on April 16–18, 1957, cosponsored by the American Institute of Chemical Engineers, Nuclear Division; American Nuclear Society; American Society for Testing Materials; Atomic Industrial Forum; and Society for Nondestructive Testing.

The atomic energy installations and contractors participating in the symposium included: Argonne National Laboratory, Battelle Memorial Inst., Hanford Products Operation, Los Alamos Scientific Laboratory, National Lead Company of Ohio, Oak Ridge National Laboratory, Phillips Petroleum Co., du Pont Savannah River Laboratory, University of California Livermore Laboratory, and Westinghouse Atomic Power Division.

More papers were offered for the symposium than could be presented orally in the three-day session. Many of these were presented by title only at the symposium but have been included in the symposium proceedings. Some of the topics covered include: survey lectures on nondestructive testing in the nuclear energy field, eddy current methods, ultrasonic methods, and radiation techniques including autoradiography; testing of reactor components, and fuel assemblies including both general techniques and specific applications; in all, there are 42 papers.

STP 223; 420 pages; cloth cover; price: $10; to members of the sponsoring societies, $7.50.

Symposium on Ion Exchange and Chromatography in Analytical Chemistry

This symposium is the first of a series of annual symposia planned on timely subjects concerned with the analysis of materials. New methods and new techniques capable of use in standard methods of analysis will be discussed in this series.

This publication describes methods available or under development for ion exchange and chromatography. Some basic theory is given together with examples of its application to metal analysis.

The papers were presented at the 59th Annual Meeting held in Atlantic City, June, 1956, under the auspices of Committee E-3 on Chemical Analysis of Metals.

Contents

Introductions
Ion Exchange in Analytical Chemistry—Robert Kunin
Ion Exchange in Analytical and Radiochemistry—J. E. Hudgens, Jr.
Metal Separations by Anion Exchange—Kurt A. Kraus and Frederick Nelson

STP 195; 62 pages; hard cover; price $2.25; to members, $1.80.

Symposium on Radiation Effects on Materials, Volume Two

THIS is the second of a series of symposia on Radiation Effects on Materials sponsored jointly by ASTM and the Atomic Industrial Forum. The data and evaluations presented are made as a contribution to the understanding of existing code and specification values as they apply to nuclear reactor structures and components. The known properties of materials must be evaluated in the light of the actual reactor operating conditions. By adapting and interpreting the vast backlog of data on unirradiated materials with the sparse but accumulating knowledge of irradiated materials, it is stated that cautious extrapolation within the limits of experimental work can be allowed.

This symposium will be of special value to those interested in the design and operation of nuclear reactors. This volume is well illustrated.

Contents

Introduction—G. D. Calkins and C. C. Woolsey

Selection of Structural Materials for Components of Nuclear Power Plants—W. L. Fleischmann

Problems in Standardization of Techniques in Radiation Effects Studies—M. J. Feldman and R. H. Fillnow

Application of the Battelle Research Reactor to Radiation Effects Studies—J. W. Chastain

A Technique for Measurement of Electrical Resistivity of Radioactive Metals—C. L. Boyd

Techniques of Tension Testing Irradiated Materials at Elevated Temperatures at Hanford—W. S. Kelly, D. C. Kaultiz, and R. E. Hueschen

Techniques for Making Visual Examinations and Dimensional Measurements at Hanford's Radiometallurgy Laboratory—D. L. Zimmerman

Hanford's Improved Remote Metallographic Equipment—J. R. Morgan

Effect of Heat Treatment and Burnup on Radiation Stability of Ten Per Cent by Weight Molybdenum-Uranium Fuel Alloys—G. D. Calkins, J. E. Gates, F. A. Rough, D. O. Leeser, and A. DelGrosso

Engineering Effects of Radiation on Nuclear Fuels—B. Lustman

A Survey of the Radiation Stability of Hydrocarbon Fuels—J. G. Carroll, R. O. Bolt, and J. A. Bert

Selection of Organic Materials as Reactor Coolant-Moderators—E. L. Colichman and R. H. J. Gercke

Effects of Radiation on Electronic Components—I. Semiconductor Devices—M. A. Xavier, S. Nelson, A. Yefsky, A. Walters, and G. J. Rotariu

STP 220; 140 pages; hard cover; price $3.75; to ASTM, AIF members, $3.

Manual on Measurement and Sampling of Petroleum and Petroleum Products

The third edition of the ASTM Manual on Measurement and Sampling of Petroleum and Petroleum Products has just come off press. In addition to the seven methods included in the previous editions, which have been brought up to date, this new edition also includes, for the first time, two additional methods: Sampling Electrical Insulating Oils (D 923–56) and Sampling Liquefied Petroleum Gases (D 1265–55).

This manual contains all of the available ASTM methods for measuring quantities of petroleum and its products and for obtaining representative samples thereof for testing and analysis. These standards, widely used by both buyer and seller in transactions involving large quantities of petroleum and petroleum products, have been revised in this third edition to improve their usefulness and practicability. They are written concisely, yet in sufficient detail to permit the procedures to be followed without further instruction. It is believed that this ASTM Manual represents the best and most practical measurement practices in use today.

This new Manual comprises 168 pages and is available in both cloth and paper binding at the following prices: Paper binding $3.50, to members, $2.80. Cloth binding $4.25, to members, $3.55.

Standards on Iron Castings

As a result of direct requests from the foundries and purchasers of foundry products, ASTM is publishing for the first time a special compilation of its industry-wide standards covering iron foundry products. Many classes of gray iron, malleable iron, and nodular iron castings are included in the 32 specifications and test methods which comprise the book. Also covered are such products as pig iron, soil pipe, culvert pipe, and pressure pipe and such mechanical tests as compression, impact, and torsion. Chill testing, radiographic terminology, and charts for evaluating graphite flake size and type are some of the other important items included.

Prepublication orders indicate a wide interest in this special compilation of ASTM Standards on Iron Castings.

176 pages; paper cover; price $2.75; to members $2.20.

ASTM Issues New Section of X-Ray Powder Data Cards

SECTION EIGHT of the X-Ray Powder Data Card File, covering approximately 500 inorganic materials and 325 organic materials, is now available in the plain card form. Also included is a list of data in the first seven sections which have become obsolete. The Keysort cards are being punched by the McBee Company and should be ready shortly. There will be a delay of several months before the data are available in IBM form. Prices will be as follows:

	Plain	Keysort	IBM
Part 1 (Inorganic)	$50	$ 90	$40
Part 2 (Organic)	$70	$100	

Additional sets can be purchased, by companies who place orders for more than one, at prices as follows:

	Plain	Keysort
Part 1	$20	$30
Part 2	$25	$40

A new Index book (*Special Technical Publication 48-G*) has also been issued, which is supplied without charge with each order. Extra copies of this 700-page book can be obtained for $12 per copy.

For shipments abroad all the above prices will be slightly greater to cover export packing and shipping.

X-ray powder data analysis identifies a material by means of its atomic arrangement. It is therefore useful whenever it is necessary to identify the state of combination of the chemical elements or phases present. This can be applied to a mixture of several substances. It is used to a great extent for analysis of alloys, clays, corrosion products, industrial dusts, pharmaceuticals, minerals, refractories, and wear products. Instances of extreme usefulness in checking chemical processes have been reported. Compared with ordinary chemical analysis, the diffraction method requires only a small sample, is nondestructive, and is usually much faster.

This powder data file has been compiled by the Joint Committee on Chemical Analysis by Powder Diffraction Methods.

Errata in Symposium on Titanium

In the paper by W. M. Parris, R. G. Sherman and H. D. Kessler on "Elevated-Temperature Properties of the 6 per cent Aluminum, 4 per cent Vanadium Titanium Alloy" in the Symposium on Titanium, STP 204, Figs. 7 and 10 have been interchanged. These figures appear on pages 56 and 57.

Thermal Properties of Metals

Today's technological developments present many heat transfer problems involving the utilization of the thermal properties of materials. The thermal properties of present concern are: thermal conductivity, thermal expansion, specific heat, and density. Thermal diffusivity, another important thermal property, may be calculated from the known values of thermal conductivity, specific heat, and density. Values of many of these properties are not too abundant in the literature. A program conducted by Battelle Memorial Institute for the Wright Air Development Center was directed toward the experimental determination of the named thermal properties of 13 metals.

Extensive data are supplied for two grades of aluminum, chromium, copper, two grades of inconel, magnesium, molybdenum, monel K, and 4 grades of steel. Compiled by C. F. Lucks and H. W. Deem.

STP 227; 30 pages; paper cover; prices $1.25; to members, $1.

ASTM Standards on Light Metals and Alloys

This compilation of ASTM specifications and methods of test for light metals and alloys has been prepared to make these standards available in convenient form. It includes not only those specifications and methods of test which come under the jurisdiction of Committee B-7 on Light Metals and Alloys, but also those for light metal alloy die castings, prepared by Committee B-6 on Die Castings, and those for aluminum wire and cable for electrical purposes, sponsored by Committee B-1 on Wires for Electrical Conductors.

Several methods under the jurisdiction of Committee E-1 on Methods of Testing and Committee E-3 on Chemical Analysis of Metals have been added so that the compilation will be as useful as possible. In addition specifications for arc-welding electrodes and for brazing filler metal under the jurisdiction of the ASTM-American Welding Society Joint Committee on Filler Metal have been included.

Among the general topics covered are: ingots; castings; bars, rods, wire, shapes; forgings; pipes, tubes; sheet, plate; filler metal; and electroplating. There are 51 standards of which 36 are new, revised, or have had their status recently changed. It supersedes the December 1955 edition.

320 pages; paper cover; price: $3.75; to members, $3.

Bibliographical Abstracts of Methods for Analysis of Synthetic Detergents

This book supplements the August, 1956, edition with the same title, STP 150-A. It brings the references up to 1957 and covers additional references, not previously listed, back to 1933. The volume was prepared by Jay C. Harris for Subcommittee T-2 of ASTM Committee D-12 on Soaps. There are subject and author indexes.

STP 150-B; 28 pages; paper cover; price $1.50; to members, $1.20.

ASTM Specifications for Steel Piping Materials

This edition is intended to replace the December, 1956 issue. It includes revisions approved by Committee A-1 on Steel in 1957 for all the previously included specifications as well as several new specifications first issued in 1957. The specifications in this compilation cover (1) pipe intended to convey liquids, vapors, and gases at normal, elevated, and subnormal temperatures, (2) still tubes for refinery service, (3) heat exchanger and condenser tubes, and (4) boiler and superheater tubes. To complete the volume, specifications are included for the following products used in pipe and related installations: (1) castings, (2) forgings, (3) bolts and nuts.

Included for the first time are requirements for extra low-carbon grades of stainless steels in tubular form and for schedules 5S and 10S welded stainless pipe, 14 to 30 in. in diameter, for corrosive or high-temperature service. There are many other very important revisions including the provision for supplying the new basic oxygen steel in two of the pipe specifications.

The first issue of this compilation in 1942 was developed in cooperation with the prime movers committee of the Edison Electric Institute. Many of the specifications are incorporated in the ASME Boiler and Pressure Vessel Construction Code.

478 pages; paper cover; price $5; to members, $4.

ASTM Standards on Paper and Paper Products and Shipping Containers

This compilation of various ASTM standard and tentative specifications, test methods, and definitions of terms pertaining to paper and paper products, and shipping containers are grouped together in this publication. It is believed that it will be useful to producers and consumers as well as others interested in these materials fields.

In the development of test methods, Committee D-6 and Committee D-10 each cooperate with the Technical Association of the Pulp and Paper Industry through joint ASTM-TAPPI Committees. Many of the methods in this publication have been reviewed by the appropriate joint committee. The designations of the corresponding TAPPI methods are given at the top of the title pages of the respective standards.

There are 102 standards and related information in this compilation. Of this number, 6 are new, revised, or have had their designations recently changed. This edition supersedes the September, 1955 issue.

420 pages; paper cover; price $4; to members, $3.20.

Errata in 1957 Part I Supplement

Several typographical errors have occurred in the Tentative Specifications for Carbon Steel Sheets of Flange and Firebox Quality (ASTM Designation: A 414 – 57 T) in the 1957 supplement to the Book of ASTM Standards-Part 1, p. 204. These are as follows:

Table II.—In the first column where the sheets are grouped into various thickness ranges under elongation, the range of "0.1499 to 0.0890" should read "0.1449 to 0.0890."

Section 7 (b).—In the third column of the table in this section the thickness range of "0.0871 and under" should read "0.0971 and under."

Errata

January 1958 ASTM BULLETIN

The following errors have been discovered in the text of the paper by Sigurd Groennings, "Determination of Total Naphthenes in Gasoline:"

Page 65, Fig. 1
The label for the lower cluster of points should be "Naphthenes."

Page 67, Table III
Difference ($n - d/2 -$ IR Naphthene Contents, per cent by Volume: "($n - d/2 -$ IR. . ." should be "($n - d/2) -$ IR. . . ."

Page 67, Column 2, tenth line:
"C_5 to C_6" should be "C_5 to C_7."

APRIL 1958

NO. 229

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

ASTM Bulletin

Materials Data Is Our Business

ASTM is deep in the data business—nonprofit of course. By data we mean collection of information about materials from the literature, from sponsored research, and from other sources, and the publication of these data in several different forms. The data include engineering properties of materials as well as basic physical constants—such things as tensile strength, modulus of elasticity, creep properties, etc., for metals; viscosity and density data for hydrocarbons and certain chemicals; and spectral data—infrared and ultraviolet absorption spectra on chemical compounds. Another large project is the collection and publication in cooperation with several other societies of X-ray diffraction data on a wide variety of inorganic and organic chemicals of a crystalline nature, or having crystalline phases. These various data projects are sponsored by several ASTM committees and joint committees.

Of particular interest are trends noted in presenting these data for rapid and systematic retrieval and correlation. Both the X-ray diffraction data and the spectral absorption data are offered on punched cards for those who are in position to use them in that form. Plans are underway to present the data on properties of metals at high temperatures sponsored by the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals on punched cards also. Presently these data are published in both tabular and graphical form.

The Society is cooperating with the Office of Critical Tables of the National Academy of Sciences—National Research Council in a national effort to coordinate critical data on materials. There is no question that there is a need for such coordination. Growth of technology in recent years has added greatly to the volume of such material available and needed. Further information on this important work will appear in a future issue of the BULLETIN.

ASTM Described to CSI in Dallas

Edwin Joyce, Vice-Chairman of the Southwest District Council and recently associated with the API, addressed the Dallas Chapter of the Constructions Specifications Inst., Wednesday, January 8, in Dallas.

In his address, Mr. Joyce particularly stressed ASTM history, organization, and procedures, stressing the effort to secure representation from all interests with a balanced membership of producers, consumers, and general interests. He briefly outlined ASTM's financial structure. The close relationship between CSI and ASTM was warmly praised.

Continuing in this program of ASTM-CSI cooperation, H. P. Hagedorn, Chairman of the ASTM Chicago District, will address the Chicago Chapter of CSI soon. Leroy C. Gilbert of the ASTM staff will talk on the ASTM standards program of the Delaware Valley Chapter of CSI.

SOCIETY OFFICERS NOMINATED

ASTM President, Vice-President, and five Directors, were named by the Nominating Committee at its meeting in St. Louis, February 13, 1958. In accordance with the bylaws of the Society, the committee announces the following nominations:

For President (1-year term):

K. B. Woods, head, School of Civil Engineering, and Director, Joint Highway Research Project, Purdue University, Lafayette, Ind.

For Vice-President (2-year term):

A. A. Bates, vice-president of research and development, Portland Cement Assn., Chicago, Ill.

For Directors (3-year term):

P. A. Archibald, chief metallurgist, Standard Steel Works Division, Baldwin-Lima-Hamilton Corp., Burnham, Pa.

W. L. Fink, chief, Metallurgy Division, Alcoa Research Laboratories, Aluminum Co. of America, New Kensington, Pa.

H. M. Hancock, manager, Product Control Dept., The Atlantic Refining Co., Philadelphia, Pa.

L. A. O'Leary, head, Chemical Engineering and Research Dept., W. P. Fuller & Co., South San Francisco, Calif.

A. C. Webber, senior supervisor, Experiment Station, E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept., Wilmington, Del.

The By-laws provide that "further nominations, signed by at least 25 members, may be submitted to the Executive Secretary in writing by May 25, and a nomination so made, if accepted by the member nominated, shall be placed on the official ballot" which "shall be issued to members between May 25 and June 1."

ACR Notes

Administrative Committee on Research

Cooperative Research

By R. C. ALDEN[1]

ONE OF the outstanding features of the modern scientific era is the strong trend toward cooperative research. This is not to say that old-fashioned proprietary research and basic research are things of the past. These, too, are growing at a rapid rate. If there is any slowing in any direction, it is the "lone wolf" who is losing the race.

The advent of very large governmental research, at home and abroad, is the outstanding manifestation of cooperative research. In fact it is so outstanding it may mask the many other tendencies in the same direction. But on every hand there is evidence of the trend for groups of organizations to band together for the achievement of mutual research objectives.

More trade associations, both as consumers and producers, are sponsoring more, and larger, research projects. The rapid growth of research institutes, in number and in size, probably is due more to projects sponsored by groups than to projects sponsored by units.

The basic requirement for a well-conceived cooperative research project is, of course, that there is a problem the successful solution of which will result in profits to the sponsors. Over and above this there is the general characteristic that either the cost of the project is too high, or the profits too small, to justify the cost to be included in the budgets of even the largest units of the sponsoring group. Sometimes it is a characteristic of a cooperative research project that, to be most successful, its findings must be utilized by an entire industry. And, often new developments and materials confront producers and consumers requiring fresh, outside investigations on a broad front. These are some of the motivations for growth of cooperative research.

The American Society for Testing Materials, in its special field of developing standards for the materials of commerce through cooperative research by producers and consumers, is ideally conceived and organized to fit in with the trend noted. Indeed, the Society might claim distinction as a very early pioneer in cooperative research.

Looking toward the future, with its proliferating materials of engineering, it is important to enhance the spirit of cooperative research in the Society so that the standards fostered by ASTM will continue to represent the latest and best in the knowledge of materials. There are numerous ways in which this can be done—for example, (1) the sponsorship of more ASTM symposia to define the standardization problems of various materials, (2) more aggressiveness toward the publication of ASTM cooperative research results, and (3) vigilance in noting new fields where standardization is needed.

In any event, it behooves all those interested in the Society to realize and to preach that ASTM is one of the outstanding examples of the profitability of cooperative research. Ordinarily standardization is the end of progress, but in ASTM standardization is dynamic, ever-changing as new facts from cooperative research are brought to bear on today's complex materials of engineering.

[1] Phillips Petroleum Co. (Retired), Bartlesville, Okla.

Thank you, St. Louis

Some say that frequently an organization or an event is but a shadow of some efficient, dedicated individual. Certainly the major share of credit for the outstanding success of the nontechnical features of our Committee Week in St. Louis should go to the General Committee Chairman A. Carl Weber, Director of Research and Sales Engineering, Laclede Steel Co. With considerable experience in such affairs as dinners, luncheons, fund raising, and the like, Carl headed the Finance Committee, aided in publicity, and, in general coordinated activities splendidly. He climaxed his activities by serving as an extremely entertaining toastmaster at the dinner, where some 50 of St. Louis' top management were guests. Cooperating closely with him were the officers of the St. Louis District: chairman J. M. Wendling, City of St. Louis Municipal Testing Lab.; vice-chairman W. C. Magruder, Carter Carburetor Co.; secretary A. M. Siegel, Industrial Research & Testing Labs.; and S. B. Roberts, past district chairman who was treasurer. Others who helped greatly were past national director, Howard K. Nason, vice-president, Monsanto Chemical Co., who presided at the Steel Industry Luncheon and who secured Dr. C. A. Hochwalt as the Chemical Industry Luncheon speaker, and F. Guy White, Granite City Steel Co., an active District and committee member, who brought his President as the Steel Industry Luncheon speaker and helped in a variety of ways. Other St. Louisans—past or current District members—helped Mr. Weber and his group. The General Committee included in its roster over 90 leading executives and technical people in St. Louis, including Mayor Tucker.

To the St. Louisans, sincere thanks for a job well done.

Photostress Demonstrated in Philadelphia

Doctor Felix Zandman, Director of Basic Research for the Tatnall Measuring Co., demonstrated a unique technique for experimental stress analysis called Photostress. Despite a heavy blizzard in the Philadelphia area more than 40 members of the District attended a meeting held Tuesday, February 18, at the Franklin Institute.

Using slides, motion pictures, and working models, Doctor Zandman showed that Photostress worked as an infinite number of strain-gage rosettes of infinitely-short gage length. He discussed many applications and variations to which it could be put to use, including work as a transducer for pressure, load, and torque.

Some of the other aspects demonstrated were in area scan, residual-stress patterns, detection of subsurface flaws, and determination of unbonded areas in sandwich construction. A lively discussion followed the meeting. Tinius Olsen II, Chairman of the Philadelphia District, presided.

District Activities

Left to right: Myron Niesley, Chairman ASTM Southern California District Council; Robert J. Painter, Executive Secretary ASTM; Richard T. Kropf, President ASTM and Vice-President Belding Heminway Co., Inc.; Alvin T. Herzig, President, Climax Molybdenum Company of Michigan, principal technical speaker; D. S. Clark, California Institute of Technology, Past-President ASM, active ASTM member, winner Charles B. Dudley Award; W. H. Eisenman, Secretary ASM; John Wilson, California representative American Metal Climax Inc., Chairman Northern California Chapter ASM; Messers Niesley and Wilson shared presiding responsibilities.

LOS ANGELES and SAN FRANCISCO

Gillett Lecturer, A. J. Herzig, Speaks on Molybdenum

During their recent trip to the West Coast and the Southwest, ASTM President R. T. Kropf and Executive Secretary Painter attended excellent meetings in Los Angeles, where the meeting was joined with the Los Angeles Chapter, American Society for Metals, and in San Francisco the following week, where the San Francisco Section of the ASME joined with our Northern California District. At each of these meetings, held on January 23 and 30, respectively, President Richard T. Kropf was the coffee speaker; and the technical presentation was a version of the 1957 Gillett Memorial Lecture dealing with molybdenum and its promising alloys by Mr. Alvin J. Herzig, President, Climax Molybdenum Company of Michigan, and Vice-President of the parent company, who used many of the fine illustrations he had incorporated in the original lecture, and also included the movie showing the melting of molybdenum.

President Kropf Talks about the Future Shortage of Scientists

President Kropf discussed the road to the future, indicating that our tremendous population increase could probably be handled, according to those concerned with these problems, from the standpoint of food; and with the potentialities of thermonuclear power, energy should be available. He left his audience thinking about the problem of the necessary scientific and technical manpower which in the next 25 to 50 years promises to be very short indeed.

At the Los Angeles Meeting with ASM, National Secretary Eisenman was present and made appropriate remarks, commenting on the ASM program of the future and the progress being made in this program, including the work on the new national headquarters building. ASTM Secretary Painter referred to the 1958 Annual Meeting at Boston at which Dr. Clyde D. Williams will be the Gillett Lecturer, speaking on High-Temperature Metals—Their Role in the Technological Future.

Present at the meeting as guests of the Society were the following chairman, or other officers representing him, of some ten of the local chapters or sections of other professional societies:

Dave O'Conner, Department of Water and Power, Chairman, Local Section, American Welding Society

P. A. Sorenson, Richfield Oil Co., Representing American Society of Lubrication Engineers

Paul Pariseau, Turco Products, Representing American Chemical Society

Leo Soffa, Northrop Aircraft, Chairman, Society for Nondestructive Testing

Henry M. Layne, Consulting Structural Engineer, Chairman, American Concrete Inst.

John Buckwalter, Douglas Aircraft, Chairman, Society of Automotive Engineers

Frank Warga, Airesearch Manufacturing Co., Chairman, American Foundrymens' Society

Shuman More Foster, Wheeler Co., Chairman, American Society of Mechanical Engineers

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

Date	Group	Place
May 16	Western New York-Ontario District	Buffalo, N.Y.
May 21	Philadelphia District	Trenton, N.J.
May 26–27	Committee D-10 on Shipping Containers	Stamford, Conn. (Roger Smith Hotel)
June 2–6	Committee E-14 on Mass Spectrometry	New Orleans, La. (Hotel Jung)
June 22–28	**Annual Meeting**	**Boston, Mass. (Statler and Sheraton Plaza Hotels)**
Sept. 24–26	Committee E-14 on Mass Spectrometry and British Institute of Petroleum, Mass Spectrometry Panel	London, England (Univ. of London)

Joe Dorsey, Southern California Gas Co., National Association of Corrosion Engineers

William V. Wright, Electro-Optical Systems, Chemical-Metals Branch of American Institute of Mining and Metallurgical Engineers

In San Francisco, reference was made to the Third Pacific Area National Meeting to be held there during the week of October 11, 1959. It was indicated that the membership of many of the chapters and sections of other societies in Northern California, in fact in the West Coast Area in general, will be receiving details of this meeting. Dozier Finley, Chairman of the 1949 General Meeting, and Mr. George Rait, a long-time former member of the Society were present.

Sessions on Accelerated Testing and Life Qualities of Materials Featured at Albuquerque

On January 27, the first ASTM Meeting to be held in Albuquerque took place at the Student Union Building of the University of New Mexico. There were several interesting papers dealing with important problems of accelerated testing and life qualities of materials in the symposium developed by Howard E. Montgomery of Sandia Corp. The discussion arising from the question and answer period following each paper indicated keen interest in the subject.

Original impetus to the symposium and meeting was given by ASTM Past-President John R. Townsend, who was Engineer of Materials Standards there, but who has since gone with the Defense Department in Washington and unfortunately could not witness the fine program that had evolved from his suggestion.

A list of the papers and speakers follows:

Welcoming Introduction—. M. E. Farris, Dean of Engineering School, University of New Mexico

Accelerated Aging Tests and Life Aging Properties of Aircraft Metal Adhesives—J. P. Thomas, Convair, Division of General Dynamics

Testing and Exposure Life Test on Metallic Coatings—C. H. Sample, International Nickel Co.

Testing for Mold and Fungus Resistance of Materials in Storage—. C. J. Wessel, National Academy of Sciences–National Research Council

Concrete and Its Life Qualities—W. K. Wagner, Albuquerque Gravel Co.

Testing and Exposure Life Tests on Paints—Ralph Wirshing, General Motors Research Laboratories

Irradiation of Polymers—. Richard Bauman, B. F. Goodrich Laboratories

Looking Ahead to the Year 2000—R. T. Kropf, President, ASTM, Vice-President, Director of Research, Belding Heminway Co.

Engineering and Technical Societies at Work—R. J. Painter, Executive Secretary, ASTM

It will be noted that the authors came from leading organizations concerned with the subjects covered, many coming from a considerable distance. It was naturally gratifying to those who had worked so hard on the program to note an attendance of about 135, many of course coming from the Sandia Corp., but there was representation at the meeting from Denver, Salt Lake City, Tucson, and other points several hundred miles distant.

Since it is expected that several of the papers will appear in published form, no attempt is made here to provide a synopsis or abstract.

Melvin Jackson, consulting engineer, Colorado Builders Supply Co. of Denver, presided at the morning session, and P. J. Elsey, assistant director, Utah Engineering Experiment Station, University of Utah, Salt Lake City, was the technical chairman in the afternoon.

All eight of the students at the University of New Mexico selected for their scholastic work in courses relating to ASTM activities were present to receive their student membership prize awards, these being presented by President Kropf just before the close of the afternoon session.

SOUTHWEST

Petroleum and Textiles Featured in Special Sessions

During the visit to Houston early in February of President Richard T. Kropf and Executive Secretary Painter, the Southwestern District arranged a very full program. This included a series of papers on textiles, especially cotton, in cooperation with the Texas Cotton Improvement Board, a special style show, and a luncheon address by President Kropf. Later a dinner was held at which the President spoke, followed by a technical meeting where an address was presented by Mr. Harry W. Ferguson, vice-president, Marketing and Production, The Humble Oil Co. The latter events were held by the Southwest District jointly with Committee D-2 on Petroleum Products and Lubricants which was holding a week-long meeting in Houston.

Clarence H. Sample, Chairman of Committee B-8 on Electrodeposited Metallic Coatings, and ASTM President Richard T. Kropf, attending the Life-Test Symposium, Albuquerque, N. M., July 23, 1957.

Because of the President's interest in textiles (he is Vice-President and Director of Research at Belding Heminway), the District arranged through Mr. Earl E. Berkeley, Director, Fiber Laboratory, Anderson, Clayton, and Co., to join with the Texas Cotton Improvement Board in discussing various aspects of this very important material. A list of the papers follows:

Appraisal of Hybrids Between Species as Material for Cotton Improvement—C. F. Lewis, Texas Agricultural and Mechanical College

Textile Testing Instruments—The Tools of Technology—C. A. Baker, United States Testing Co.

American Cotton's Position in World Commerce—H. Whittington; Anderson, Clayton & Co.

Recent Progress in the Chemical Finishing of Cotton—C. H. Fisher, Southern Regional Research Laboratory

Man-Made Fibers—P. C. West, E. I. du Pont de Nemours & Co.

Since publication of either the papers or extended abstracts is being considered, no attempt is made here to give in detail the subjects covered. The papers were ably presented and each stimulated considerable discussion.

In his talk "Fibers, Fabrics, Fashions Future" President Kropf noted the development of many of these materials and reiterated his view that the battle of the fibers is not good for the industry.

At the evening dinner, Paul L. DeVerter, Humble Oil and Refining Co., Southwest District Chairman, presided and introduced the officers of Committee D-2 on Petroleum Products and Lubricants and of the District. Executive Secretary Painter confined his remarks to several questions relating to

Part of the Southeastern District Innaugural Meeting was a tour of the Research Laboratories of the West Point Manufacturing Company, Shawmut, Ala. Pictured here, from left to right, are: R. J. Painter, ASTM Executive Secretary; R. T. Kropf, ASTM President; Mr. Hame, Am. Assn. of Textile Chemists and Colorists (fourth from left); H. F. McDonnell, Florida State Road Department; C. J. Blackman, Atlantic Steel Co., and Mr. Fisher, Research Director of West Point Manufacturing Co.

the future growth of ASTM which are now being considered by the Long-Range Planning Committee—the matter of meetings, publications, name of the Society, operation of committees, and the like.

President Kropf, the dinner speaker, took a look into the future, stressing the matter of great population growth. He observed that the tremendous amount of food stuffs and materials necessary to feed and clothe this large population can be produced if all our facilities are used reasonably; the problem of energy will be solved through the development of thermonuclear power. Commenting on the large number of engineers and scientists needed, he gave no answer to this very perplexing situation, but left the thought that engineers and scientists must get together and continue to impress all concerned with the field of engineering education of the necessity to turn out more, and better, trained, technical people.

The Committee D-2 Secretary, W. T. Gunn, Director, API Division of Refining, introduced his fellow, committee officers at the meeting, as well as Mr. Ferguson, who is the API vice-president this year, heading the Refining Division.

Since an extended abstract of the address by Mr. Harry W. Ferguson, vice-president, Humble Oil and Refining Co., Production and Merchandising, will appear in the May issue, only a note or two is given here. He reviewed the activities of the American Petroleum Inst., especially those which are of interest to ASTM, and then noted ASTM activities which concern, and which receive intensive support, by the petroleum group. He emphasized certain factors in the future of the industry, especially the growing petrochemical field where sales now amount to billions of dollars, and will rise even higher in the future. Here is a field where there will continue to be a definite need for standards. The speaker paid high tribute to ASTM for the contributions it is making to the industry.

In addition to Messrs. DeVerter, Berkeley, and Frank Chairez, efficient secretary of the District, who is with Eastern States Petroleum Co., others who helped in the series of meetings were Briggs Manuel, W. H. Curtin and Co., and Milton Holmberg, Consultant.

This District, one of the newer ASTM groups, adds to its previous laurels a very full day of successful activities in the interest of ASTM.

NEW YORK

Safe Handling of Flammable Solvents

Static electricity was described as one of the most common causes of explosions and fires in industrial plants by Mr. G. E. Cain, a safety engineer of the Hercules Powder Co., in his address on "Safety in Handling Flammable Solvents" before more than 270 people attending a joint meeting of the New York District and the New York Paint and Varnish Production Club. His lecture featured experiments demonstrating that even small quantities of static electricity, if not properly grounded, can spark fires. Solvents often used in painting and spray techniques may create conditions conducive to fires and explosions. In a lively discussion following his talk, Mr. Cain stressed the importance of grounding equipment that is used in spraying and of keeping work areas clean.

One way to insure safe grounding is to check equipment for resistance to ground. Equipment giving readings of 0 to 5 ohms to ground is considered safe, in the opinion of Mr. Cain. Other safety measures described include the use of inert gases where the hazard of explosion exists and the use of proper venting to dispose of explosive fumes.

President Dunn of the New York Paint and Varnish Production Club acted as chairman for the meeting held Thursday, Feb. 6, 1958 at New York City. Mr. A. A. Jones, vice-chairman of the New York Council, briefly discussed the scope and activities of the New York District of the ASTM before the featured address.

Central New York May Form Society's First Section

An exploratory meeting was held Wednesday, March 5, in Rome, N. Y., to determine the feasibility of forming a Central New York Section essentially a small District. Among those who attended the meeting were Past-President R. A. Schatzel, William A. Mader, F. J. Szurek, A. H. McKinley, and B. F. Richardson. Others attending the meeting included E. O. Deimel, C. J. Hamlin, L. E. White, and A. E. Coon. F. F. Van Atta, Assistant Secretary, and A. L. Batik represented Headquarters at the meeting.

The unanimous opinion of the group was that a Section should be formed in the Central New York State area, but that it should remain, for the time being, a part of the New York District. Bruce F. Richardson of the Utica Metals Division, Division of Kelsey-Hayes Co., was chosen acting chairman and William A. Mader, Oberdorfer Foundries, was selected as acting secretary. The New York District Council will be asked to approve the action taken by the group and simultaneously the Administrative Committee on District Activities will be asked for authorization to form the first Section ever established by ASTM. This will require confirmation

by the Board of Directors, which may be possible at the time of its May meeting.

The formation of Sections is a step to provide industrial areas with an official ASTM organization when they are geographically isolated from major centers of population. The Central New York Section, it is hoped, will prove a fruitful testing ground for this type of organization.

OHIO VALLEY

Shrinking Portion of Consumer Dollar Spent on Paint Industry

Drawing on his long experience in the paint industry, J. S. Long, distinguished professor, University of Louisville and director of the Paint Research Inst., addressed a joint meeting of ASTM Committee D-1 on Paints, Ohio Valley District, and the Louisville Paint and Varnish Production Club on "Research in Protective Coatings." He revealed that only one-half of one per cent of the consumer dollar is used for labor and materials allied with the paint industry; since this indicates quite a reduction in recent years, perhaps the paint industry has not kept up to date in its basic thinking but is leaning too much on tradition. He used many examples to show the possibility of advancement and advocated basic research as a means of preparing for the future. He also enumerated current problems and spoke of partial solutions under development, giving many interesting details of the work being done at the Paint Research Inst.

Mr. George Heh, president of the Louisville Paint and Varnish Production Club, president at the dinner meeting attended by more than 170 people and held in the Kentucky Hotel, Thursday, March 6, in Louisville, Ky. Among those attending the meeting were officers of the Ohio Valley District and Committee D-1. Mr. Moore of the ASTM Board of Directors also attended the meeting.

ASHAE and ASRE Plan to Merge

The American Society of Heating and Air-Conditioning Engineers and the American Society of Refrigerating Engineers have unanimously approved further study of a method for merging the two societies. It is expected that at the summer meetings in 1958, final merger plans for the two societies will be presented and approved.

ASTM Study Committee on Cermets Organized

A Study Committee on Cermets was organized on February 12 during ASTM Committee Week in St. Louis. The need for this committee has been evident for some time to appraise the requirements for testing these new materials described as "cermets." Cermets, a combination of ceramic and metallic materials with unique high-temperature properties, have shown considerable promise to meet the requirements for materials which will withstand the stress and high temperatures involved in jet engines and rocket propulsion motors.

There has been much research and development on cermets, mostly of an isolated nature. Several of the ASTM technical committees have devoted some attention to the subject, including committees in the fields of metals and ceramics, each approaching the problem from the point of view of their particular interest. In order to review this field of materials more thoroughly and to establish the emphasis which should be given to the subject, the study committee was asked to analyze the present status of cermets in industry and to make recommendations to the Society's Board of Directors on what should be done toward the establishment of proper standards.

One of the first problems facing the committee is the selection of a proper definition of the materials now loosely called cermets. The selection of an appropriate term is complicated by the lack of clear-cut definitions of such common terms as "ceramic," "metal," and "alloy." A definition which is being considered by the group is "a heterogeneous body composed of two or more intimately mixed, but mechanically separable, phases, of which at least one is metallic and one ceramic."

Initial work of the committee will include the circulation of a questionnaire in order to obtain a list of existing standards which might be applicable with or without modifications, and development of a symposium on the properties of cermets to be presented at the 1959 Annual Meeting.

The study committee plans to hold its next meeting on April 28 in Pittsburgh at the time of the Annual Meeting of the American Ceramic Society.

J. R. Tinkelpaugh of Alfred University, Alfred, N. Y., was elected chairman of the committee.

New Committee on Solvents

The ASTM will increase its already extensive activity in the organic solvents field by establishing a new Committee, D-26, on Halogenated Organic Solvents. With the approval of the Society's Board of Directors, an organizing committee under the chairmanship of M. A. Pinney of the Pennsylvania Railroad is undertaking the preliminary work to establish the committee, which will be formally organized at the Annual Meeting of the Society during the week June 22–27, 1958. The following scope for the new committee has been recommended:

Scope.—The promotion of knowledge pertaining to halogenated organic solvents and admixtures thereof, including formulation of specifications, definitions, and methods of test.

Standards peculiar to electrical insulating liquids, paint thinners, and nonhalogenated components of admixtures normally are excluded from the scope of Committee D-26, and developments in these fields incidental to the work of Committee D-26 will be coordinated with the appropriate technical committees of the Society.

The Society has already established test methods and specifications covering many organic solvents, including such widely used materials as Stoddard solvent and a number of aromatic hydrocarbons such as benzene, toluene, and xylene. The new committee will concentrate its efforts on the solvents containing halogens, that is, chlorine, fluorine, etc., including trichloroethylene, perchloroethylene, and solvent mixtures containing these halogenated solvents, together with other types of organic solvents.

Subcommittees are proposed covering Definitions and Nomenclature, Vapor Degreasing, Cold Cleaning, Test Methods, and Industrial Hygiene and Safety.

A number of companies engaged in the production and use of cleaning solvents have expressed interest in participating in the committee's work. The Society welcomes participation by other companies which may be interested in this new committee. Further information on participation in the work of the committee may be obtained from ASTM Headquarters.

Committee Week in St. Louis

Steel and Chemicals Featured at Industry Luncheons

Symposia on Ozone Resistance of Rubber and Mortars Highlight Full Programs

Two industry luncheons—an innovation at ASTM Committee Week—were held as a part of the week-long series of meetings at the Hotel Statler, St. Louis, February 10–14. On Tuesday, February 11, Nicholas P. Veeder, president of the Granite City Steel Co., was the speaker at the Steel Industry Luncheon sponsored by ASTM Committee A-1 on Steel.

Dr. Carroll A. Hochwalt, vice-president, research, development and engineering, Monsanto Chemical Co., was the speaker at the Chemical Industry Luncheon sponsored by ASTM Committees D-11 on Rubber and D-24 on Carbon Black, on Wednesday, February 12.

A special feature of the week was an address by William M. Holaday, director of guided missiles for the Department of Defense, given at the dinner sponsored by the St. Louis District. Mr. Holaday's address appears beginning on page 50.

As is usual for the Annual ASTM Committee Week, there were many committee meetings devoted, for the most part, to completing recommendations on standards to be made to the Society at the 61st Annual Meeting in June. Altogether some 1100 technical men registered to attend over 280 committee and subgroup meetings of 35 ASTM technical committees. Some of the highlights of these activities are reported under Technical Committee Notes in this issue.

ASTM Vice-President F. L. LaQue and Carroll A. Hochwalt, who gave the principal address, attending the Chemical Luncheon—one of the Industry luncheons held during Committee Week.

A two-session symposium on the Effect of Ozone on Rubber, comprising eight papers, was sponsored by Committee D-11 on Rubber and Rubber-Like Materials. Symposium chairman was G. C. Maassen, R. T. Vanderbilt Co.

A Symposium on Mortars, comprising seven papers, was sponsored by Committee C-12 on Mortars for Unit Masonry, as a feature of an open meeting of the committee.

Tomorrow's Standards—*Equations of State?*

As knowledge is gained about the ultimate structure of materials, it will become increasingly likely that standards can be written to define fundamental properties according to Dr. Hochwalt, vice-president of Monsanto Chemical Co., speaking at the Chemical Industry Luncheon.

"Perhaps the target of tomorrow's standard should be equations of state. Into an equation of this nature will go the molecular and atomic parameters of a given composition of matter. Ideally, out of it will come the precise strength at a given temperature, at a given loading rate; the dielectric properties at a given frequency; the thermal properties and other data necessary to complete definitions of the engineering behavior of the material.

"While this is a lofty target," Dr. Hochwalt observed, "it is probably one of the most challenging technical problems which engineering has ever faced."

Dr. Hochwalt's address will appear in full in a later issue of the BULLETIN.

Steel Luncheon—one of the Industry Luncheons held during Committee Week.

Luncheon for authors of papers given at the Symposium on Effect of Ozone on Rubber held during Committee Week.

Los Angeles Smog Harms Rubber

Ozone has long been known as one of the causes of knife-like cuts in rubber. Though it is a natural constituent of the atmosphere in small concentrations, ozone is formed in larger quantities by photochemical oxidation of organic materials by sunlight in the presence of oxides of nitrogen—the same chemical reaction responsible for the Los Angeles smog, according to A. J. Haagen-Smit who participated in the Symposium on Effect of Ozone on Rubber during Committee Week. Rubber has been found to deteriorate rapidly in the Los Angeles area as well as in other areas where the ozone concentration is appreciable. This situation is likely to continue for some time, and much effort has been applied toward inhibiting the ozone reaction with rubber as well as in understanding the chemistry of the reaction. Plans are to be publish as a *Special Technical Publication* the symposium papers as follows:

Rubber and Its Environment—A. J. Haagen-Smit, Calif. Inst. of Technology

The Study of the Action of Ozone with Polybutadiene Rubbers and the Inhibition of This Action—E. R. Erickson, Augustana Research Foundation

The Reaction of Ozone with Rubber—Harold Tucker, B. F. Goodrich Research Center

Ozone Resistance of Elastomeric Vulcanizates—Z. T. Ossefort, Rock Island Arsenal

Chemical Antiozonants and Factors Affecting Their Utility—William L. Cox, Universal Oil Products Co.

Prevention of Ozone Attack on Rubber by Use of Oils and Waxes—S. W. Ferris, S. S. Kurtz, and J. J. Sweely, Sun Oil Co.

Comparison of Accelerated and Natural Tests for Ozone Resistance of Elastomers—G. N. Vacca, Bell Telephone Labs., Inc.

Methods of Measuring the Extent of Ozone Cracking—A. G. Vieth, B. F. Goodrich Research Center.

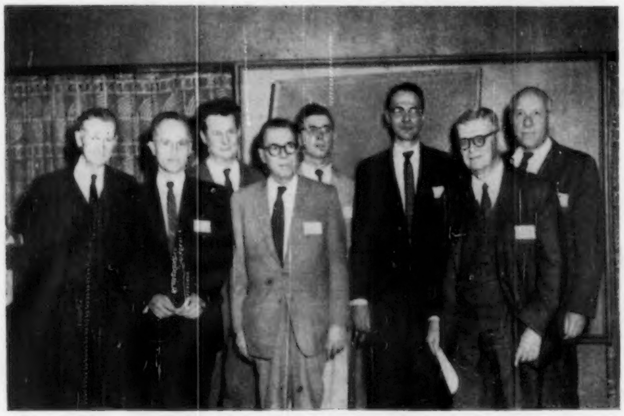
One of the more than 280 committee and subgroup meetings held during Committee Week. The group shown above was concerned with tubing specifications.

Galvanized Roofing Standard, a Case History

At the Steel Industry Luncheon on February 11, an audience of more than 200 heard Nicholas P. Veeder, president of the Granite City Steel Co., tell of the interesting experiences his company and its metallurgists have had in developing, producing, and selling new products. Of special interest were his remarks concerning the adoption and publication of a particular ASTM Standard for galvanized iron or steel roofing sheets. There had been a period in which some steel mills not regularly engaged in manufacturing galvanized products would jump into the galvanizing market during periods of low demand for their regular products and produce a low-quality material. This badly affected the reputation of galvanized roofing sheets because they were very lightly coated with zinc and rusted soon and excessively. When the ASTM standard became available, it helped the producer by stabilizing the market and by eliminating price cutting based on quality cutting, thereby helping galvanized roofing to regain its reputation of durability. The users at the same time were helped by giving them an understandable, measurable way to judge the quality of commercial grade galvanized roofing sheets.

Properties of Mortars Discussed at Symposium

Workability and the proper selection of materials were stressed as the two most important factors of a good masonry at the Symposium on Mortars sponsored by ASTM Committee C-12 on Mortars for Unit Masonry, during Committee Week. This program of informal papers and discussion was well attended due to the broad interest in masonry construction.



Luncheon for authors of papers given at the Symposium on Mortars held during Committee Week.

Seven papers were presented leading off with a paper on the "Essential Properties of a Good Mortar," by John W. McBurney, materials consultant, formerly with the National Bureau of Standards and a long-time member of Committee C-12. Mr. McBurney referred to a presentation by J. C. Pearson in 1939 which listed the essential properties of mortar in the order of their importance. Workability was first, and Mr. McBurney believes that this is still the most important property. The second, soundness, is now not so much of a problem due to the use of pressure lime. Bond strength is still a live subject. Strength, both tensile and compressive, which ranked ninth in 1939, remains as one of the lesser properties as load-bearing masonry walls are not being used as much as formerly.

A method of determining bond strength was described by Cyrus C. Fishburn, research associate, national Bureau of Standards, in a paper entitled "Structural Testing Methods in Investigating Mortar as a Factor of Wall Strength." The elasticity of mortars and its implications was discussed by Walter C. Voss, consultant on architectural construction and materials and formerly Head of the Building Engineering and Construction Department of M.I.T. In summarizing, Professor Voss stressed the need for a low modulus mortar to decrease rigidity and the need for frequent relief joints where high-strength mortar is required. He stated that the engineer should cease idolizing strength and pay more attention to the selection of the components, particularly in reference to climatic exposures.

In a progress report on "Research on the Durability of Mortar," presented by W. L. Zematis, instructor of testing materials at Lafayette College, data were presented showing the effect of entrained air on the freezing-and-thawing test.

Two short papers were presented on the "Effect of Sand Grading Upon Some Mortar Properties." C. U. Pierson, Jr., technical director, Southern Cement Co., reported on bond test studies in his laboratory. The need for improvement in sand gradings was expressed. The tensile bond test was proposed as a criterion in establishing proper sand gradings. Walter Washington, Sumner Sollit Co., discussed various gradings of a sand in mortar mixes, presenting data from an exploratory investigation of the behavior of sand with gradings not meeting ASTM specifications. The sand cone method (ASTM Designation C 128) was found not entirely reliable in establishing the saturated surface-dry condition of sand. Mr. Washington stated that it was entirely likely that sand with unusual gradings, normally considered to be very poor, might be satisfactory if the grading is such that voids are low and the fineness modulus is in a suitable range.

The results of tests of bond between masonry grout and reinforcing steel were reviewed by William Lerch, Portland Cement Association.

Harry C. Plummer, director of engineering and technology, Structural Clay Products Institute, presided as symposium chairman.

Head table at the Committee Week Dinner at which William M. Holaday, Special Assistant to the Secretary of Defense, was the speaker. The photograph at the bottom of the following two pages shows, from left to right: Robert J. Painter, ASTM Executive Secretary; J. M. Wendling, ASTM St. Louis District Council chairman, City of St. Louis Municipal Testing Laboratory; Howard A. Coleman, vice president in charge of sales, Missouri Portland Cement; C. E. Heitman, president, Carter Carburetor Co.; M. E. Skinner, vice president, Union Electric Co.; John G. Moore (Col.), vice president, Mallinckrodt Chemical Works; J. Kenneth Hyatt, vice president in charge of engineering, Anheuser-Busch, Inc.; C. L. Clark, The Timken Roller Bearing Co.; Norman L. Mochel, manager, metallurgical engineering, Westinghouse Electric Corp. and past president ASTM; Roy P. Hart, vice president, Missouri Pacific Railroad; F. L. Laque, vice president and manager of Development and Research Division, The International Nickel Co., ASTM junior vice president; Don A. Fischer, dean of engineering, Washington University; L. W. McLeod, regional vice president, Westinghouse Electric Corp.; William M. Akin, president, Laclede Steel Company; James S. McDonnell, president, McDonnell Aircraft; K. B. Woods, head, Civil Engineering Department, Purdue University and director of Highway Research Project, chairman Highway Research Board; William M. Holaday, (speaker), director of guided missiles, Department of Defense; A. Carl Weber, (Toastmaster), director of research and engineering, Laclede Steel Company; Aloys B. Kaufmann, president, St. Louis Chamber of Commerce and former mayor of St. Louis; Rev. Victor J. Blum, dean, Institute of Technology, St. Louis University; Carroll A. Hochwalt, vice president, Monsanto Chemical Co.; N. P. Veeder, president, Granite City Steel Co.; Howard I. Young, president, American Zinc, Lead & Smelting Co.; Arthur B. Atkinson, president, Wabash Railroad; C. H. Fellows, director Engineering Laboratory and Research Department, The Detroit Edison Co., past president ASTM; O. G. Haywood, vice president and manager, Emerson Electric Manufacturing Co.; E. B. Meissner, Jr., president and general manager, St. Louis Car Co.; Emmett H. Mann, vice president, Leschen Wire Rope Division, H. K. Porter Co.; Edw. Golterman, administrative assistant to the mayor of St. Louis; Brice R. Smith, executive vice president, Sverdrup & Parcel; J. M. Black, vice president, Southwestern Bell Telephone; Howard K. Nason, vice president and general manager, Engineering Division, Monsanto Chemical Co., and past director ASTM; F. H. Pillsbury, president, Century Electric Co.; R. E. Petering, executive vice president, Emerson Electric Manufacturing Co.; Everett E. Carlson, president, Engineers Club of St. Louis; E. A. Kirbey, president, Arthur S. Schwartz, vice president, Nooter Corporation; R. E. Hess, Associate Executive Secretary, ASTM.

MISSILE RELIABILITY—

A Challenge to Materials Engineers

by WILLIAM M. HOLADAY

Missiles and their unusual reliability requirements usher in a new era of materials, testing, and standards according to William M. Holaday, Special Assistant to the Secretary of Defense and long active member of ASTM, in an address highlighting the recent Committee Week activities at St. Louis

OUR missile work began in earnest a little over a decade ago—just about the end of World War II. At that time there was little information available on supersonic flight—the turbojet was an infant—no ramjet had been successful, and solid rocket fuel was a new field. Radars were also relatively new—although they had produced a terriffic effect on the outcome of the war. The electronic industry was truly in the beginning stage when viewed in the light of demands missiles were to make.

From Small Start, Real Progress

From this austere beginning, one cannot but conclude that astounding progress has been made in that short span of years. The progress has not come about by accident or through the leisurely efforts of a few people. It has resulted from the concentrated work of the nation's best scientists and the dedicated efforts of many many thousands of Service and industry personnel.

Today, for example, there are more than one hundred thousand people directly involved in our surface-to-surface missile programs alone. What the number is for all missile programs, I do not know, but without question it is truly big in comparison with the handful of people so involved ten years ago.

Similarly, the national expenditure for guided missile developments and production has risen by corresponding leaps and bounds. The total money obligated on missiles during fiscal year (FY) 1947 was 58 million dollars. The annual obligation had risen to slightly more than 1 billion dollars in FY 1952. Five years later, the FY 1957 figure was 4.4 billion dollars. The preliminary total for FY 1958 looks like something over 5 billion dollars and the FY 1959 projection is about 5.8 billion dollars. It is interesting to note that the projected missile obligation for FY 1959 is exactly 100 times as great as it was in FY 1947.

Through the efforts and money expended thus far we have placed operational missile systems of all types in the hands of our Armed Forces. These include surface-to-surface, surface-to-air, air-to-surface, and air-to-air systems. In certain cases third generation systems are about to be deployed. While no intercontinental or intermediate range ballistic missiles are presently operational, it will not be long before they are.

We should be justly proud of these achievements, and I do not feel that the over-all status of the Russian missile developments is a bit better than our own at the present time. Holding this view and having confidence in the nation's ability to develop and produce whatever is required, I found it difficult to understand the reaction of many people to the Russian Sputnik. To these people something seemed to have been lost, and the only course of action they could understand was to scatter in all directions seeking its recovery. However, I believe our recent success with the satellite will help restore a necessary and proper faith in the nation's present missile and space development efforts as well as those which are to come in the future.

Committee Week Dinner

Committee Week Report

WILLIAM M. HOLADAY is Special Assistant to the Secretary of Defense for Guided Missiles. Earlier in his distinguished career he has served as Deputy Assistant Secretary of Defense (Research and Engineering) and Director of Research of the Socony-Mobil Oil Co. For many years he was active in the work of ASTM Committee D-2 on Petroleum Products and Lubricants and was long associated with fuels and lubricants research in various agencies of the Government.

Sputnik Dramatizes Need for Public Understanding

To me, the one thing that the Russian satellite demonstrated most clearly was the over-all need of our people for a better grasp of fundamental principles and the true nature of technical progress. Such an improved understanding should do much toward increasing general stability of thought and purpose which I feel is so necessary for national success. The problem is not transitory and is one which must be dealt with by each succeeding generation. Without increased backing and respect for our scientists, engineers, and technicians, we may fail to progress at a rate necessary for our survival.

Of course, a general appreciation of fundamental principles and understanding of the nature of technical progress is far from enough on the part of those, such as yourselves, who must actually solve the complex research, design, development and testing problems associated with missile work.

Reliability, Key to Success

Materials required by guided missiles have never before been subjected to such terrific environmental conditions. The shock of launching, accelerations, vibrations, and heat problems are an order of magnitude greater than any previously encountered. And yet the reliability of our missiles must be high because without it we have nothing.

In the early postwar days of missile development, there was a tendency to enter flight testing without adequate attention to the aspects of reliability. This was a concept aimed at gaining time with the thought that building reliability into the system components was something that could wait until the production phase.

Fortunately, it did not take too long for us to discover the error of our ways. Before we did, however, the initial test phases of several missile systems were beset with casualty after casualty when time was of the essence. The result was a waste of scientific and engineering effort, much money, and precious time.

When the attempt is being made to demonstrate system feasibility, the initial flights are perhaps the most important of all. This is the time to do everything possible to insure that failure does not occur. If there is ever a time for over designing in the interest of reliability, it is in the initial flight program when each flight is so vital.

There is no magic by which reliability can be obtained. There are no tricks, no cheap ways, no easy roads. The attainment of reliability is an engineering problem which requires elaborate information on materials and a thoroughly coordinated engineering effort to produce a proper design. This must be followed by production and inspection techniques embracing the highest order of perfection. Once a good design has been attained—one in which components are not required to operate at their maximum limits—one in which mechanical strengths are sufficient to withstand the accelerations, vibrations, and temperatures encountered in flight—then there is an excellent chance that we shall be well along the way toward achieving true reliability in our missile systems.

(See caption on page 49)

A New Era of Testing

A considerable portion of this reliability problem is leading to materials engineering and testing techniques which I think can be properly described as a new engineering field in its own right.

The technological race in the development of missiles has extended our interest in environment testing far beyond the experience of the industrial and academic world. Here we run into such problems as high-speed aircraft and missiles being heated by air friction to temperatures exceeding their kindling and melting points. Extremely high altitudes bring up the problem of irradiation we may encounter in near and outer space. There is also the problem of behavior of materials subjected to nuclear radiation. Another problem of considerable importance is that of high intensity sound. It has been observed that the sound energy of a jet motor or rocket motor may cause fatigue and failure of aircraft surface plates. The older environments of shock and vibration are intensified by the higher speeds, larger masses, and greater inertial forces. Furthermore, modern weapons are required to maintain their capability to operate when projected at high velocities from one medium to another, such as from air to water, water to air, or from air to ground. Explosive forces have been accelerated to the point where pressures of tremendous amounts will be experienced by all types of structures both new and old. We also shall experience combinations of these environments, and this all conspires to create a situation where we must revise and add to all of our basic design criteria.

As you well know, one of the most difficult problems in materials engineering is the determination of transitory properties and state of being of materials undergoing deformation at high velocities and for very short periods of time. For example, when a guided missile enters the earth's atmosphere from a tremendous height, it may be proceeding at a velocity twenty times that of sound. The missile will thus generate in the lower atmosphere a temperature of such a high intensity as to completely evaporate any known material. However, time is required for heat generated on the surface to penetrate the object so that the period of time the structure is exposed to high temperature is an important engineering design consideration. Even though we have developed some materials for applications of this type, we need to know a great deal more about the state of materials when subjected to these great forces within a short time period.

A New Era of Materials

In the past, and as a matter of engineering convenience, materials of construction have been tested and evaluated on an individual basis. We are now entering a field where single properties or combinations of properties of simple materials are not sufficiently good to meet our engineering needs. Consequently, composite structures made up of metals and plastics held together by adhesives, or metals and wood held together by adhesives, or indeed an infinite variety of combinations, may prove desirable. We have very little engineering design data regarding the behavior of materials in sandwich or other forms of composite structure. This is an important and highly neglected field of materials engineering.

Radiation from nuclear propulsion and that expected to be experienced at high altitude may prove to be highly destructive to many materials of construction. In building nuclear reactors, intensive studies have shown that nuclear radiation can destroy cohesiveness of plastics as well as stiffen lubricants and hydraulic fuels. A whole new area of technology having to do with the ability of materials to resist nuclear radiation most be explored.

A severe limitation on propulsion and motor development now exists because of our inability to realize the high efficiency and high thrust that would otherwise be possible with known fuels if they could be contained. Tremendous interest is needed in developing refractory materials that can be used in aircraft engine developments, jet propulsion, and for surfaces of high-velocity missiles.

We are face-to-face with a situation that requires much more work on all known materials. Essentially, what is needed is the development of test methods that will permit us to evaluate known materials under these new environmental conditions. These methods of test should also be capable of determining properties of materials in excess of the normal elastic limit and where the time function is so important. I understand that our Society has already required its various standing committees to gather information on the effect of radiation upon materials.

A New Era of Standards

Another task important to all of us is that of establishing standards of measurement, testing, and specifications for materials. Our specifications should be more comprehensive and easily understood by the widest possible group of contractors and subcontractors. Present weapons systems are so complicated that a vast number of contractors and subcontractors must be employed. These contractors are located all over the United States and in friendly foreign countries as well. Accordingly, standards of fit, quality, test definition, and nomenclature will have increasing importance if we are to achieve reliability with these highly complex systems.

The activities of this Society touch all of these considerations at one point or another. I urge that efforts in these regards be emphasized and expanded to help meet the present and future problems in the materials area.

Papers to Appear in Future Issues of the ASTM Bulletin

Creating Test Atmospheres at −260 F—John Brown and Gordon V. Thompson, The Martin Co.

Small Tunnel-Furnace Test for Measuring Surface Flammability—H. D. Bruce and V. P. Miniutti, U. S. Department of Agriculture.

Tests for Engineering Properties of Ceramic Tile—J. Vincent Fitzgerald and E. L. Kastenbein, Rutgers University.

Flame-Spread Properties of Building Finish Materials—Daniel Gross and Joseph J. Loftus, U. S. Department of Commerce.

Corrosion of Concrete by Sulfuric Acid—W. C. Hansen, R. P. Vellines, and W. W. Brandvold, Universal Atlas Cement Co.

Power Separation Filter for Corona Studies—Neta P. Sheps, Bell Telephone Laboratories, Inc.

The Elastometer—A Simple Device for Measurement of Elastic Moduli at Elevated Temperatures—Robert A. Spurr, Hughes Aircraft Co., Morris J. Heldman and Howard Myers, East Los Angeles Junior College and Douglas Aicraft Co., Inc.

Nitric-Hydrofluoric Acid Evaluation Test for Type 316 L Stainless Steel—Donald Warren, E. I. du Pont de Nemours & Co., Inc.

Criterion for the Evaluation of Roof Coating Asphalts—C. E. Wilkinson, L. Striker, and R. N. Traxler, The Texas Co.

Technical Committee Notes

ASTM technical committees—the backbone of the Society—hold meetings throughout the year. They meet in Florida, in Texas, in New England, in California, and even in Canada and Mexico. Many make it a regular practice to meet every year during ASTM Committee Week in February and at the Annual Meeting in June. A few of the many interesting things that took place at most of these meetings during the last month or two are reported on this and the following pages. The actions on standards are subject to letter ballot in the respective committees and for the most part, will be reported to the Society in June.

Metals

Steel

Steel for concrete reinforcement continues to receive much attention from Committee A-1 on Steel. A new specification for uncoated wire for prestressed concrete has been developed, and work is being started on a new specification for high-strength, billet-steel reinforcement with a yield strength of 75,000 psi.

Revisions will also be proposed for adoption in the specifications for basic billet-steel, rail-steel and large-size, billet-steel reinforcing steel to change the yield point for the hard grade from the present required minimum of 50,000 psi to 60,000 psi. Building code requirements for reinforced concrete (ACI 318-56) adopted by the American Concrete Inst. already recognize these changes.

In 1957, the Society modified the specification for steel pipe for ordinary uses (A 120) to permit production by the basic oxygen process. Changes in other specifications permitting this process will be submitted to the Society for approval this year including steel pipe for special uses, specifications for hot-rolled and cold-rolled steel bars, structural steel, steel sheet, and strip.

Cast Iron

A project at the Southern Research Inst. under the Joint ASTM-ASME Committee Steam Power Panel to determine the properties of cast iron at temperatures of 800 to 1200 F has been completed, according to a report presented at the meeting of Committee A-3 on Cast Iron during Committee Week.

The committee is planning corrosion studies on gray iron, and will expose specimens with the malleable iron, nodular iron, and cast steel atmospheric corrosion test plates under the sponsorship of the Advisory Committee on Corrosion.

Corrosion

Committee A-5 on Corrosion of Iron and Steel is now collecting approximately 800 samples of hardware with various metallic coatings to be exposed at three test sites (Kure Beach, N. C. 80- and 800-ft sites, and Newark (New York Area), N. J.). This test is much larger than the hardware field tests which were begun about 28 years ago. The original program still continues at the State College, Pa., test site; the exposure at four other test locations have been discontinued.

A method for determining the amount of aluminum in coatings on steel is being prepared. This method will serve as a basis for a specification for aluminum-coated steel.

The cooperative work on magnetic gages is now complete, and the data are being studied statistically for presentation at the next meeting. A new program to prepare specifications for corrugated metal culvert pipe and corrugated metal under-drain pipe was begun at the meeting held during Committee Week.

Magnetic Properties

Outstanding developments in the field of magnetic materials in the past few years has prompted ASTM Committee A-6 on Magnetic Properties to review its scope of activity to determine where expansion is needed so as to better serve the industry. This matter and others were discussed at the meeting of the committee on February 13, during Committee Week.

Recent developments in magnetic materials include, in particular, the ferrites—ceramic materials having magnetic properties—which are currently being considered also by a group in Committee C-21 on Ceramic Whitewares. New developments also include permanent-magnet ceramics as well as special magnetic materials for magnetic amplifiers and saturable reactors.

The committee has completed development of an extensive revision of methods of test for alternating current core loss and permeability of magnetic materials (A 343), and this is to be included in this year's annual Report. The revision represents the results of several years of investigation by members of the committee.

Malleable Iron Castings

L. C. Marshall of the Link Belt Co. presented a report on elevated temperature stress rupture studies of malleable iron at the meeting of Committee A-7 on Malleable Iron Castings during Committee Week. In view of the interest in such studies, the committee established a new subcommittee on high-temperature properties of malleable iron.

Specimens have been collected for atmospheric exposure tests at marine sites in North Carolina and California, at industrial sites near New York and Chicago, and at a rural site near State College, Pa. These include standard and pearlitic malleable, as well as steel and nodular iron. This program is under the sponsorship of the Advisory Committee on Corrosion.

Electrical Heating, Resistance, and Contact Alloys

Contact Transients Studied

Electrical contacts used in rotating electrical machinery can be the source of serious radio interference according to a report by Carl Allen of the International Electronic Engineering Co., at a meeting in Washington, D. C., on February 25, of Committee B-4 on Electrical Heating, Resistance, and Contacts. Mr. Allen has been conducting an investigation in cooperation with the Stackpole Carbon Co. in making radio-frequency measurements from 150 kc to 25 Mc at the terminals of rotating electrical equipment with various kinds of contact material on the slip rings. A typical voltage-frequency curve ranged from about 8000 μv at 150 kc down to about 5 or 6 μv at 25 Mc. It was found that the measurements could be used to indicate the relative amount of noise produced using different kinds of contact materials. It was also found that the general type of curve of voltage *versus* frequency has a surprising resemblance to a calculated curve obtained from the Fourier analysis of a square wave.

At the subcommittee meetings, work was completed on several new methods for recommendation as tentative, including an accelerated life test for iron-chronium-aluminum alloys, and a specification combining three existing specifications for heating alloys. Also approved for ballot was a tentative method for evaluating microcontacts.

Die Cast Metals and Alloys

New mechanical property requirements for all the aluminum die-casting alloys, except G8A, have been decided upon for final approval of Committee B-6 on Die-Cast Metals and Alloys as reported at Committee Week meetings. Also new ratings for resistance to corrosion and other characteristics will accompany these changes.

Experimental work is under way for determining the mechanical properties of zinc alloys when they are die cast in evacuated dies.

Metallic Coatings

Committee B-8 on Electrodeposited Metallic Coatings at its Committee Week meetings presented a report summarizing observations on factors which influence the adhesion and retention of adhesion of (clear) organic coatings to chromium plate. A recommended practice for cleaning metals prior to electroplating has been completed, and this item, together with the report on adhesion, will be included in the committee's Annual Report.

Active projects reported at the meeting include: a new study of ductility of both thin and thick electrodeposits, preparation of a specification for chromate treatments of cadmium plate, development of a test for solderability of electrodeposited coatings, and a review of comments on the monograph on electroless nickel.

Fatigue

The final draft of a report "Tentative Guide for Fatigue Testing and the Statistical Analysis of Fatigue Data" was approved by ASTM Committee E-9 on Fatigue during its Committee Week meeting. It is being released for publication in mimeograph as a supplement to the manual on fatigue testing, *STP 91*. It will fill an increasing need for the application of statistical methods in estimating the fatigue characteristics of one sample of specimens and for comparing two or more sets of fatigue data.

A questionnaire circulated to about 300 organizations inquiring as to present and future research projects under way in the fatigue field is nearing completion. The report will cover replies from over 30 government agencies, 25 universities, and 45 industrial organizations reporting on 175 topics.

A project covering the cross referencing of the yearly abstracts of literature references was also reported well under way. Seven yearly abstracts have been published and these will become referenced as to subject matter. This work will be published as a further means of greatly increasing the utility of these abstracts.

Nondestructive Testing

Eddy current testing has become such an important phase of nondestructive testing that Committee E-7 on Nondestructive Testing is organizing a new subcommittee to cover this subject. An organizational meeting of this new group will be held at the ASTM Annual Meeting in June. Anyone interested in this subject and willing to participate in the committee's work should communicate with A. Gobus, Secretary of Committee E-7, Philips Electronics, Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Nonmetallic Construction Materials

Refractories

A collaborative study of the method for determining the thermal conductivity of carbon refractories from a single point determination has recently been completed by several laboratories and was presented to Committee C-8 on Refractories at its Committee Week meetings. A newly developed procedure for the hydration of dead-burned magnesite is being evaluated in an interlaboratory test program. Another collaborative test program will evaluate a method for determining the permeability of carbon refractories. The production of refractory brick high in alumina has made necessary the revision of the classification of fire clay brick (C 27) to include brick containing up to 80 per cent Al_2O_3.

Progress is being made on the preparation of a new chrome-ore standard sample for chemical analysis. This new sample will replace the National Bureau of Standards Standard Sample No. 103 which has just recently been exhausted.

Work is continuing on standard tests for mullite brick, hot-plate spalling tests, a study of temperature distribution in hydrometric-cone-equivalent furnaces, product density of insulating fire brick, and a classification of basic refractory brick.

Gypsum

Gypsum backing board will now be included in the group of specifications under the jurisdiction of Committee C-11 on Gypsum, which met during Committee Week. This board consists of an incombustible core, essentially gypsum, with or without fiber, and surfaced with paper firmly bonded to the core. An insulating backing board included in the specification is covered with aluminum foil. There is also a special fire-resistant type of board known as "Type X." This proposed specification is in final stages of development.

Definitions for gypsum formboard and for Type "X" gypsum wallboard were approved for inclusion in the existing list of definitions (C 11).

The drying of plaster prior to painting is a problem which has been before the industry. A statement of the problem has been prepared for submittal to the Administrative Committee on Research in an effort to enlist further aid outside of the committee. An interesting presentation on radiation effects as it pertains to gypsum and gypsum products was presented by two representatives of ASTM Committee E-10 on Radioisotopes and Radiation Effects, J. E. Whitney and P. K. Conn.

Thermal Insulation Committee Takes New Look at Specs

A new philosophy of specifications—specifications based on performance rather than on composition—was presented to the members of Committee C-16 on Thermal Insulating Materials at its meeting on March 7 in Hollywood, Fla. The present specifications under the jurisdiction of Committee C-16 are based on material composition. In addition to the idea of specifications being based on performance, it was stressed that all requirements should be fully covered by ASTM test methods and that the demand for materials specifications, when required, should come from the consumer and not the producer. By this philosophy materials would be divided into classes according to performance requirements, for example, temperature range. Some materials so classified might meet requirements of more than one class. Quoting a prominent member of the committee, "Too often our specifications *describe* the material rather than *prescribe* the values below which the material should not go." It is planned to distribute examples of suggested performance specifications to the committee members to be followed by more definite discussion at the next meeting of the committee.

A proposal for reorganization of the committee was also presented which, though independently prepared, would fit into the suggested rewriting of specifications as referred to above. The reorganization would also be based on classification of materials. Subcommittees under the proposed reorganization would be classified as follows: pre-molded (pipe and block); formed-in-place (wools, plastics, cements); blanket, board and sheet; coverings, coatings and attachments; thermal conductance or resistance; properties other than thermal; and associated and general standards. The proposed reorganization is being studied.

Specifications and test methods for blanket-type thermal insulation and fibrous loose fill are being developed. A proposed specification for vermiculite loose fill insulation was also circulated for comments and for comparison with the corresponding Federal Specification HH-I-585.

The method of test for thermal conductivity using the guarded hot plate (C 177) — which is the most widely known and used test in the thermal insulating field — is undergoing extensive review and research in an attempt to improve upon agreement of results. The alundum plate in particular will receive intensive study. A new method of test for thermal conductivity at low temperatures using the Wilkes Calorimeter has now been approved by the committee and will be presented to the Society in its 1958 Annual Report. The committee is evaluating the reliability of the method of test for water vapor transmission of materials used in building construction (C 355T) by a cooperative test program.

In the field of special thermal properties a proposed method of test for mechanical stability a method for measuring total emissivity, and a method for maximum use temperature of thermal insulation were approved for committee letter ballot.

Expanding its coverage of recommended practices, the committee approved for ballot a proposed recommended practice for prefabrication or field fabrication of thermal insulation of fitting covers. With the acceptance of a proposed method of making and curing test specimens of mastic thermal insulating coatings, subject to confirming letter ballot, attention is now being given to a method of testing adhesion of a mastic applied to thermal insulation. Round-robin tests are planned to study weathering, adhesion, and the stability of adhesive coatings.

A specification for reflective sheet for insulation (one highly reflective sheet) is being developed. It will cover the composition, dimensions, and physical properties of reflective sheet used for insulating enclosed air spaces in hollow building construction.

Mortars

The publication of a second and possibly final report on efflorescence was approved at the meeting of Committee C-12 on Mortars for Unit Masonry at its Committee Week meetings. This report contains extensive data gathered by the Subcommittee on Research over a period of years.

False set is also being considered by the subcommittee with a cooperative test series planned jointly with Committee C-1 on Cement.

An entirely new specification for mortar for reinforced brick masonry is being studied. It replaces the present tentative specification C 161 which is considered inadequate. Also the tentative specification for mortar for unit masonry (C 270) will be revised to include slag cement (C 358).

Manufactured Masonry Units

A proposed new method of test for the determination of drying shrinkage of masonry units will be submitted to the Society for adoption this year, based on the actions of Committee C-15 on Manufactured Masonry Units at its meeting during Committee Week. Drying shrinkage of concrete block is a matter of primary concern to the concrete masonry industry.

The committee also completed the first phase of its work on a method of test to determine the effectiveness of coatings of waterproofing materials for unit masonry walls and advanced its work on numerous other methods of test and specifications including those applying to clay brick and sewer brick.

Road and Paving Materials

Precision of test methods as determined by statistical analysis of test data was the keynote in the reports and recommendations presented at the Committee Week meeting of Committee D-4 on Road and Paving Materials on February 14.

Based on actions taken by the committee, five new methods of test will be considered for acceptance by the Society at the Annual Meeting, June 22–27, 1958. These are (1) method of test for resistance to deformation and cohesion of bituminous mixtures, (2) method of test for kneading compaction for bituminous mixtures (3) method of test for resistance to plastic flow of bituminous mixtures using the Marshall apparatus, (4) method of test for resistance to deformation and cohesion of bituminous mixtures using the Hveem apparatus, (5) method of compaction for bituminous mixtures using the California Kneading Compactor.

Recognition was given to the Hubbard-Field apparatus in a change in the title of the method of test for resistance to plastic flow of fine-aggregate bituminous mixtures (D 1138) which will now refer to the use of the Hubbard-Field Apparatus.

Methods of AASHO and ASTM were reviewed at a meeting of representatives of the American Association of State Highway Officials, the Asphalt Institute, and members of Committee D-4.

Waterproofing

The development of specifications and methods of test for bituminized fiber pipe will be undertaken by ASTM's Committee D-8 on Bituminous Waterproofing and Roofing Materials, it was announced on February 12 during Committee Week. A new subcommittee will be organized to study this product which has had rapid expansion in use and recognition in the pipe field. The committee is also considering an expansion of its scope into the general field of industrial pitches.

Organic Materials—Chemical Products

Petroleum Products

The February meeting of Committee D-2 on Petroleum Products and Lubricants was highlighted by two symposia—one on Aircraft Applications of Hydraulic Fluids, and the other on Bulk Quantity Measurements.

The Symposium on Aircraft Applications of Hydraulic Fluids included two papers: "Measurements of Bulk Modulus of Hydraulic Fluids," by R. L. Peeler and J. Green, California Research Corp., and "Evaluating Magnetic Filters," by Kenneth A. Kander, Boeing Airplane Co.

The Symposium on Bulk Quantity Measurements included five papers covering the use of devices for automatic sampling of petroleum and petroleum products.

A proposed method of test for knock characteristics of motor fuels above 100 by the Research method was submitted to the Society for publication as information. The specifications for motor gasoline (D 439) will be revised at the Annual Meeting in June based on the 1957–1958 Bureau of Mines Survey. This will affect the octane number requirements.

The Technical Committee on Burner Fuel Oils has been reorganized for a more active program of work on (1) light fuel oils, (2) heavy fuel oils, (3) combustion tests, and (4) pumpability tests.

Butadiene measurement tables have been recommended for publication as tentative as well as a report giving a brief résumé of data and information on which the tables are based.

The committee has in progress five cooperative test programs on nine reference hydraulic fluids. One of these includes a series of flammability tests being carried on by 22 laboratories.

Committee D-2 cooperated with the ASTM Southwest District in a special program (see District Activities). The meeting, held at the Rice Hotel, Houston, Tex., from February 2 to 7, 1958 was attended by 280 people.

Aromatics

Committee D-16 on Industrial Aromatic Hydrocarbons and Related Products reported on a study to determine xylene isomers using infrared analysis which was completed by seven collaborating laboratories. A study of this method is about complete, and a proposed method of determining xylene isomers will be presented at the June meeting.

The committee is exploring the possibility of obtaining glass cells containing relatively pure chemical substances for solidification point determination. The National Bureau of Standards had made a preliminary study of the proposed methods, and standard cells of phenol, naphthalene, and phthalic anhydride are being considered. A number of corrections to the proposed method for calculation of volume and weight of benzene, toluene, and paraxylene, which was presented in the June, 1957, Annual Report are being made. A revision of the proposed method of test for thiophene in benzene (isatin method) will be presented at the next meeting.

Coal and Coke

The first draft of a method of preparing coal samples for analysis was presented for discussion at the Committee Week meetings of Committee D-5 on Coal and Coke. The method covers procedures for the preparation of samples taken both mechanically and manually for referee and routine sampling. In the light of the discussions held during the meeting, a new draft will be prepared and circulated to the members. The committee also discussed revisions in the method for sieve analysis of coke (D 293) and in the drop shatter test for coke (D 141). Projected new activities cover development of new rapid methods of analysis of coal and high-temperature tests for coke.

As in former years, the committee will be represented by several members at the meetings of International Standards Organization on Solid Mineral Fuels which will be held in England this spring.

Carbon Black

At the Committee Week meeting of Committee D-24 on Carbon Black, three methods were approved for presentation to the Society: determination of the sulfur and the volatile content of carbon black, and benzene discoloration by carbon black. Also discussed was the determination of sulfur in carbon black in which either the combustion furnace or the oxygen bomb method is used.

Methods being processed by the committee include the sampling of carbon black in bag and hopper-car loads and tests for measuring optical properties of carbon black.

Paper

Committee D-6 on Paper, at its meeting in New York on February 21, made final plans for the Symposium on Paper to be held at the Annual Meeting in June. The symposium will review new developments in the paper field and will consider the adequacy of existing test methods for testing new paper products.

The committee expanded the method of test for titanium dioxide in paper (D 921) to include a colorimetric quantitative determination using a spectrophotometer. Progress on developing a method for testing the strength of corrugated flutes was discussed. This method, which is currently used as a product control test, is being prepared in standard form for subcommittee action.

Methods which are being subjected to interlaboratory tests for improvement include a flat crush test (D 1225), a method of testing the puncture and stiffness of paperboard, the tearing resistance of cylinder boards, the bursting strength test for corrugated paperboards, and the method for sampling paper and paper products (D 585).

Electrical Insulation

Probably the most important single problem area in the electrical insulation field is that of stability of insulation under various environmental conditions, particularly high temperatures. Such problems occupied much of the attention of Committee D-9 on Electrical Insulating Materials at its meetings in Pittsburgh, February 26 to 28, 1958. While few methods for measuring stability are at the point of recommendation as tentatives, several are being recommended for publication as information. Two of these cover measurements of thermal stability of coated fabrics. Another is for measuring oxidation stability of mineral transformer oil. Still another method, which is currently in draft form, is for evaluating the thermal stability of laminates.

A number of new methods are to be recommended this year for publication as tentative. Among these are the liquid displacement method for dielectric properties of polyethylene and a method for determining peroxide number of insulating oil.

There have been some preliminary discussions in the committee concerning the desirability of establishing standards for gaseous dielectric materials.

Rubber

A report on the interlaboratory ozone test program was presented at the Committee Week meetings of Committee D-11 on Rubber and Rubber Like Materials. The objective was to determine the degree of variation that existed among laboratories with nominally identical ozone-test chambers when testing samples were prepared and cured from a single rubber mix, and to determine how well various laboratories could maintain a given ozone concentration for a period of several days. The report is being considered for publication as a part of the Symposium on Effect of Ozone on Rubber.

As the aging of rubber and plastics is a continuing problem, the committee decided to request the cooperation of Committee D-20 on Plastics in a joint effort to investigate and develop ways and means of determining the accelerated aging properties of poly(vinyl chloride) and other compositions containing substantial amounts of plasticizers.

New tentative methods of chemical analysis of natural rubber will be considered for adoption by the Society at the Annual Meeting in June. These will include procedures developed in cooperation with International Standards Organization TC 45 on Rubber for the evaluation of crude natural rubber. They cover sampling, determination of volatile matter, ash, copper, manganese, dirt, and rubber hydrocarbon content. The present procedures for acetone-soluble materials and iron now in methods for chemical analysis of rubber products (D 297–55T) will also be included. When approved, the new methods will replace the present tentative methods of test for harmful dirt in crude natural rubber (D 1278–53T).

A review of nondestructive test developments in recent years resulted in a decision to undertake the development of methods for nondestructive tests of rubber adhesives using the Magnaflux Sonizon.

New methods of test for flexible urethane foam were recommended for publication as tentative. These methods were developed in cooperation with the Society of the Plastics Industry. The structure of flexible urethane foam consists of a network of cells of uniform character which are essentially open and interconnecting. It is manufactured in sheet, strip, molded, or specific shapes. It may be either cored or solid. Size, shape, and distribution of the coring is at the manufacturer's option, but subject to the approval of the purchaser.

Specifications and methods of test for flexible foams made from polymers or copolymers of vinyl chloride were also recommended for publication as tentative. These cover cellular products containing interconnecting cells. They were also developed in cooperation with SPI.

Wood

The field of wood-base fiber and particle panel materials has expanded greatly. This has been recognized in Committee D-7 on Wood by the report at its Committee Week meetings of a subcommittee working in this field. The committee is developing definitions of terms applying to the family of ligno-cellulosic panel materials specially manufactured for use industrially as components of furniture, cabinets, and the like, and in building construction as siding, sheathing, partitions, door cores and panelling, acoustical treatments and as structural components. Also in this field of fiberboards, consideration is being given to standards for use with insulating roof deck slabs and for particle board.

In contrast to this latest field of fiberboard, the existing specification for wooden paving blocks for exposed pavements (D 52), first published in 1918, has been given critical review. As a result the specification has been completely revised to bring it up to date with the limited present usage of this material and will be presented to the Society this year. Another of the older standards, methods for establishing structural grades of lumber (D 245T) first issued in 1926, is subject to revision following the completion of an extensive study at the Forest Products Laboratory involving basic stresses for Douglas fir. A method for the accelerated field testing of wood preservatives is being developed, a draft of which will be available within the next six months.

The extensive wood-pole testing program which has been the largest single project of the committee will be completed this year. Only a small number of wood poles remain to be tested before the final report is prepared. A supplemental program involving the effect of conditioning and treating processes of southern pine poles is under way. A task group will collect data for a strength test to be developed for wood crossarms. New projects presented to the committee will include the evaluation of joist hangers—possibly in coordination with Committee E-6 on Methods of Testing Building Constructions—and the testing of ladders.

Plastics

One of the current problems in the polymer field is in estimating molecular weight. While there are absolute methods for making this determination, they are usually difficult to perform and require special equipment. A useful and easy-to-run method which, when properly interpreted, is indicative of molecular weight is the test for dilute solution viscosity. Such a method has been developed for poly(vinyl chloride) (D 1243), and a method for dilute solution viscosity of ethylene polymers is in the final stages of development. As a special feature of the recent meetings of ASTM Committee D-20 on Plastics (February 24 to 26, Pittsburgh), a paper was presented by William E. Gibbs of Goodyear Tire and Rubber Co., on viscosity-molecular weight relationships. Mr. Gibbs' paper provided a review of what is known about these relationships, enabling a useful interpretation of the viscosity in terms of molecular weight. Two other papers were presented at the research session: "Test Method for Determining Environmental, Stress-Cracking Resistance of Films," by L. R. Petrone and D. E. Gould, Bakelite Co.; and "The Use of Torsion Pendulum to Measure Crystallinity and Void Content of Objects Made from TFE-Fluorocarbon Resin," by N. G. McCrum, E. I. du Pont de Nemours.

Mr. Petrone described a novel method for evaluating stress cracking, using what he called the liquid-in-the-bag test. Mr. McCrumb presented data to show the relationship of crystallinity and density for tetrafluoroethylene resins and described a method for determining the void content from simple measurements.

Included in the actions taken by Committee D-20 were approval of a number of items to be included in the committee's annual report. Some of these are: a complete revision of the specification for polyethylene molding and extrusion materials (D 1248); and new specifications for cellulose propionate, poly(methyl styrene); and acrylonitrile copolymers.

The committee is currently developing a group of new definitions to be included in the methods of test for tensile properties of plastics (D 638).

An indication of the current interest in standards for plastic film and sheeting are three new items to be included in the annual report: specifications for nonrigid vinyl chloride plastic sheet, and methods for measuring flatness of plastic sheet or tubing and for impact resistance by a free-falling dart.

Analysis and Testing

Methods of Testing

Meetings were held in St. Louis of fourteen subcommittees and task groups of Committee E-1 on Methods of Testing during Committee Week. Action was taken on several new and revised methods of test for general application in the testing and evaluation of engineering materials.

A new method for determination of Poisson's Ratio at room temperature is being recommended for publication as tentative. It is intended for determination of Poisson's Ratio of structural materials stressed in tension and is limited to specimens of rectangular section and to materials in which creep is negligible compared to the strain produced immediately upon loading.

The Subcommittee on Tension Testing reviewed the recently developed revision of the tentative methods of tension testing of metallic materials (E 8–57 T). It was felt that this revision would provide adequate methods for all metals.

Consultation with the committees concerned with plastics, paper, textiles, and other materials was planned in order to develop the scope that methods of tension testing for nonmetallic materials should cover.

Radiation

Rapid Increase in Use of Radioisotopes in Test Methods Foreseen

A commentary by Dr. Bizzell of the Atomic Energy Commission regarding the outlook for the use of radioisotopes by American industry highlighted the meeting of Committee E-10 during ASTM Committee Week. The forecast is for a tremendous increase in use because of their ready availability, their proven utility, and increased knowledge of handling. With this in mind, the committee predicts that many of the ASTM committees in the next three years will be considering specifications and test methods involving radioisotopes. The committee is organized to handle any requests from the other ASTM committees for assistance in this work.

During the past year, experts on radiation effects have presented papers sponsored by Committee E-10 before a dozen ASTM committees, outlining the physical and mechanical changes caused in fields of products pertinent to the respective committee's work when exposed to nuclear radiation. A total of about 600 technical committee personnel have been reached in this manner.

Fire Tests

After eight years of trial as a tentative method, the method of fire hazard classification of building materials (E 84) which is commonly known as the "tunnel test" will be submitted to the Society for adoption as a standard at its Annual Meeting in June, it was announced by Committee E-5 on Fire Tests of Materials and Constructions at its meeting February 12 during Committee Week. The committee also reported that there are now four tunnel test installations in the United States and Canada. Previously, there had been only the installation at the Underwriters' Laboratories in Chicago.

The committee also advanced its work on test procedures involving smaller scale and less expensive equipment for use in evaluating flame spread characteristics in building materials. Task groups have been appointed to study the small-scale tunnel tests developed at the Forest Products Research Laboratory under a research program sponsored by Committee E-5, and the radiant panel test which has been developed by the National Bureau of Standards.

The committee also gave attention to changes and revisions in other fire test methods under its jurisdiction.

ASTM a Cosponsor of Fifth Nuclear Congress, April 5–10, 1959; Invitation for Papers

After participating as a cosponsor of the last three Nuclear Congresses, it is the consensus of the Special Administrative Committee on Nuclear Problems that ASTM should continue to be a cosponsor of these congresses and should endeavor to sponsor more papers.

On Sunday, March 16, the Nuclear Engineering and Science Conference committee, which develops the technical programs for the congresses, had its organizational meeting in Chicago. A schedule for the solicitation of papers, the receipt of abstracts, manuscripts, etc., was established. Those interested in presenting papers appropriate to engineering materials in the nuclear field are invited to write to the ASTM representative on the conference committee, C. R. Sutton, The International Nickel Co., 67 Wall St., New York 5, N. Y. They should furnish him with the title of the paper they propose to present together with a summary and an estimate of the length of the manuscript (double spaced) and the number of tables and illustrations. This information should be in Mr. Sutton's hands by July 15, 1958. After review and coordination by the conference committee, authors who have their proposed papers accepted for the program will be advised and will be expected to have manuscripts in Mr. Sutton's hands in November. The exact date will be determined later.

Gordon Research Conferences

The Gordon Research Conferences for 1958 will be held from June 9 to August 29 at Colby Junior College, New London, N. H.; New Hampton School New Hampton, N. H., and Kimball Union Academy, Meriden, N. H.

The Conferences were established to stimulate research in universities, research foundations, and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and free discussion groups. It is hoped that each Conference will extend the frontiers of science by fostering a free and informal exchange of ideas between persons actively interested in the subjects under discussion. The purpose of the program is not to review the known fields of chemistry but primarily to bring experts up to date as to the latest developments, analyze the significance of these developments, and to provoke suggestions as to underlying theories and profitable methods of approach for making new progress. In order to protect individual rights and to promote discussion, it is an established rule of each Conference that information presented is not to be used without specific authorization of the individual making the contribution, whether in formal presentation or in discussion. No publications are prepared as emanating from the Conferences.

The complete program of the Conferences was published in *Science* for February 28.

Requests for attendance at the Conferences, or for any additional information, should be addressed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R. I. From June 9 to Aug. 29, 1958 mail should be addressed to Colby Junior College, New London, N. H.

Index to Fatigue References[1]

For the past year, ASTM Committee E-9 on Fatigue has been considering methods of indexing references on fatigue. A major objective was to develop a feasible scheme for classifying the large number of references that have been assembled and abstracted over the past several years. Since collecting and abstracting publications in this field is a continuing service of Committee E-9, the method of indexing should be such as to be suitable for continuing use. Moreover, the indexing scheme should be adaptable for various types of filing (including punched-card methods) that might be employed by the numerous users of the published abstracts.

Agreement has been reached within the committee on a tentative format. This tentative index is being published herewith so that prospective users can review and comment on it. All comments received in time will be considered.

The tentative Index, presented below, contains four ordering divisions. The first order division generally identifies material classifications, since it was agreed that this would be the first type of searching for most users of the references. The second order division identifies many of the main categories in which fatigue investigations can be placed (for example, basic research, composition and processing variables, surface factors, etc.). The third and fourth order divisions further subdivide the second order division; however, no attempt was made at this stage to do this completely (as, for example, with a detailed word index). For each ordering, additional classes could be added at later times.

Upon testing the proposed Index, using about 125 references selected from the last three annual "References on Fatigue," it was found that each reference could be identified with one of the first order divisions and with one or more second order divisions. Whenever it was possible to identify (from the sometimes meager abstracts) the third and fourth order divisions, this was done. This test indicated that the tentative Index can be useful in handling the fatigue references (and abstracts). It appears relatively simple to arrange all abstracts published to date within this framework. This would provide a codified arrangement for the 1200 references collected to date and be a first step toward making these more useful.

Later, it is expected that a word index could be developed from this classification. Such an index would be preferable for some uses. Currently, it is planned to let any user of punched-card files carry out his own punching operations; however, limited experience with the tentative Index suggests that this scheme is quite adaptable to punched-card filing.

Review of the tentative Index is invited. Suggested revisions may be addressed to Dr. Horace Grover, Battelle Memorial Inst., 505 King Ave., Columbus 1, Ohio. These suggestions should be received by May 26 to permit consideration prior to the Annual Meeting.

First Order Division:

1. General (no specific material)
2. Iron and steel
3. Corrosion- and heat-resistant materials
4. Aluminum alloys
5. Copper alloys
6. Magnesium alloys
7. Titanium alloys
8. Other metallic materials
9. Wood and plastics
10. Ceramic materials
12. Joints and joining methods

Second, Third, and Fourth Order Divisions:

*X.1 —Basic research, nature of fatigue
- X.1.1 — Test-tube alloys
- X.1.2 — Single and large crystals
- X.1.3 — Correlations, physical properties
  - X.1.3.1— Resistivity
  - X.1.3.2— Thermal expansion
  - X.1.3.3— Anelasticity
  - X.1.3.4— Damping
  - X.1.3.5— X-ray
- X.1.4 — Correlations, mechanical properties
  - X.1.4.1— Tensile and impact
  - X.1.4.2— Creep
- X.1.5 — Deformation mechanisms

X.2 —Composition and processing variables
- X.2.1 — Composition
  - X.2.1.1— Alloying elements
  - X.2.1.2— Interstitials
- X.2.2 — Microstructure
  - X.2.2.1— Grain size
  - X.2.2.2— Grain orientation
  - X.2.2.3— Anisotropy
- X.2.3 — Melting, molding, and casting techniques
- X.2.4 —Primary and secondary fabrication
  - X.2.4.1— Forging
  - X.2.4.2— Rolling
  - X.2.4.3— Forming
- X.2.5 — Defects
  - X.2.5.1— Inclusions
  - X.2.5.2— Porosity
- X.2.6 — Heat treatment (excluding surface hardening)
- X.2.7 — Other factors

X.3 —Geometric factors
- X.3.1 — Size
- X.3.2 — Shape
- X.3.3 — Stress gradient
- X.3.4 — Stress concentrations

X.4 —Surface factors
- X.4.1 — Machining techniques
- X.4.2 — Polishing techniques
- X.4.3 — Surface finish
- X.4.4 — Scratch direction
- X.4.5 — Surface hardening, cold work
- X.4.6 — Surface hardening, heat treatment
  - X.4.6.1— Carburizing
  - X.4.6.2— Nitriding
- X.4.7 — Residual stresses
- X.4.8 — Surface coatings
  - X.4.8.1— Electroplated
  - X.4.8.2— Other coatings
- X.4.9 — Other surface factors

X.5 —Test variables
- X.5.1 — Speed
- X.5.2 — Combined stress

X.6 —Environmental factors
- X.6.1 — Temperature
  - X.6.1.2— High
  - X.6.1.2— Low
- X.6.2 — Corrosion and chemical attack
- X.6.3 — Fretting
- X.6.4 — Nuclear radiation
- X.6.5 — Thermal cycling

X.7 —Fatigue damage and measurement
- X.7.1 — Detection of damage
  - X.7.1.1— Prior to cracking
  - X.7.1.2— After cracking
- X.7.2 — Crack propagation
- X.7.3 — Cumulative damage
  - X.7.3.1— Prior stress or strain history
  - X.7.3.2— Rest periods
  - X.7.3.3— Understressing, overstressing
  - X.7.3.4— Coaxing
  - X.7.3.5— Step, sequential, spectrum tests

X.8 —Test methods and machines
- X.8.1 — Fatigue machines
- X.8.2 — Control apparatus
- X.8.3 — Statistical approaches
  - X.8.3.1— Design of experiments
  - X.8.3.2— Analysis

X.9 —Engineering problems and design
- X.9.1 — Service failures
- X.9.2 — Empirical reduction of fatigue information to formulas
- X.9.3 — Application of fatigue data in design
- X.9.4 — Stress-range diagrams

X.10 —Fatigue properties of structures and machines
- X.10.1 — Simple elements
- X.10.2 — Machines and components
- X.10.3 — Structures and components

X.11 —Fatigue properties of materials (data-generating studies)

X.12 —Theoretical discussions, general reviews
- X.12.1 — Theoretical treatments, fatigue and related effects
- X.12.2 — Historical summaries
- X.12.3 — Bibliographies
- X.12.4 — Books

[1] References on Fatigue, issued as Special Technical Publications, STP's 9-B (1950), 9-C (1951), 9-D (1952), 9-E (1953), 9-F (1954), 9-G (1955), and 9-H (1956).

* X denotes first order division number indicating material classification.

Insoluble residue determination in

Portland and Portland-Slag Cements

By W. J. HALSTEAD and BERNARD CHAIKEN

The ASTM method of analysis for insoluble residue in cement was found to give variable results depending upon the analyst's interpretation of the specified conditions. The authors suggest certain modifications and clarifications to increase the reproducibility of the test results. They compared the Federal method with the ASTM procedure and obtained different results for certain interpretations of the latter procedure.

The ASTM[1] and Federal[2] methods of chemical analysis for insoluble residue in portland cement are very nearly the same and it has generally been assumed that any minor differences in wording between the two methods caused no significant differences in results. Recently, however, unpublished reports have indicated that the two methods may yield different results when applied to the analysis of portland blast-furnace slag cements. In addition, it has been observed that wide differences in values may be obtained by different analysts within the same laboratory as well as in different laboratories. This is so even when the same method is utilized and regardless of the type of cement tested.

Ordinarily, most modern American portland cements are well within the maximum specification requirements for insoluble residue. Occasionally however, the Bureau of Public Roads has had to reject the use of foreign portland cements for foreign projects which exceeded the specification requirements for this constituent. In addition, many of the portland blast-furnace slag cements now produced contain appreciable insoluble residues, and some approach the maximum specified limit. For these reasons, it is desirable to improve the reliability and reproducibility of the test method. It is believed that, despite the empirical nature of the test, the elimination of variations tolerated by the present wording of the ASTM procedure would accomplish this purpose.

Accordingly, this study was made in order to determine, (*a*) the significant differences in results obtained by the Federal and ASTM methods, (*b*) any significant variations in results that might occur as a consequence of different interpretations of the wording in the ASTM procedure, and (*c*) the improvement in reproducibility made possible by more precise wording and modifications of the ASTM procedure.

Materials and Procedure

Three cements, ranging from intermediate to high insoluble residue, were selected for this study (Table I).

TABLE I.—CHEMICAL COMPOSITION OF CEMENTS, PER CENT.[a]

	Cement A, Type 1	Cement B, Type 1S	Cement C, Type 1S
Silicon dioxide	22.0	25.5	26.2
Aluminum oxide	6.5	6.8	7.8
Ferric oxide	2.4	1.7	2.3
Calcium oxide	62.4	59.2	53.6
Magnesium oxide	1.4	1.8	3.6
Sulfur trioxide	2.8	1.4	2.3
Loss on ignition	1.9	1.3[b]	0.8[b]
Sodium oxide	0.34	0.07	0.09
Potassium oxide	0.28	0.82	0.20
Phosphorus pentoxide	...	0.04	0.02
Manganic oxide	...	0.08	0.85
Sulfide sulfur	...	0.33	0.68
Titanium dioxide	...	0.28	0.28

[a] ASTM methods of analysis.
[b] Not corrected for effects of sulfide sulfur and other oxidative changes.

W. J. HALSTEAD, chemist, Division of Physical Research, Bureau of Public Roads, has been engaged in research on highway materials since 1935. Much of this time has been spent in the study and development of methods of test. He is an active member of ASTM Committees D-4 on Road and Paving Materials and C-1 on Cement.

BERNARD CHAIKEN, chemist, Division of Physical Research, Bureau of Public Roads, has been engaged in research on highway materials since 1942, concerned mainly with the chemical analysis and development of chemical methods of tests for highway materials, especially those related to portland cement concrete.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the authors. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Methods of Chemical Analysis of Portland Cement (C 114 – 53), 1955 Book of ASTM Standards, Part 3, p. 69.

[2] Proposed Federal Test Method Standard No. 158, Hydraulic Cement: Sampling, Inspection and Testing, Method 1501 (Proposed Revision of Federal Specification SS-C-158).

Cement A is a portland cement, and cements B and C are portland blast-furnace slag cements. The latter two cements were selected on the basis of their Mn_2O_3 contents, since manganese constituents in cement are generally not easily dissolved by acids. Cement B has a low Mn_2O_3 content, while cement C contains appreciable manganese.

Throughout the main course of the work, the procedure and reagents used for the insoluble residue determination was that given in ASTM Method C 114[1]. However, since the method is not specific with respect to the time delay before diluting the acid mixture, two distinct variations were generally employed. One variation involved immediate dilution of the acid mixture, while the other involved a 5-min predigestion before dilution. These variations are believed to represent the extreme conditions permitted from a reasonable interpretation of the standard method. All other specific variations in the procedure are adequately described in the text and tables.

The procedure described in the Federal method[2] was also employed in the final phase of this study for the purpose of direct comparison with the ASTM procedure. In substance, both procedures are the same, except that the Federal method specifically stipulates immediate dilution and makes use of ammonium nitrate rather than ammonium chloride in the final wash solution.

TABLE II.—EFFECT OF VARYING SPECIFIC ASTM CONDITIONS IN THE DETERMINATION OF INSOLUBLE RESIDUE.[a]

(All digestions on electric hotplate. Dilution water and sodium hydroxide were at room temperature when added.)

	Insoluble Residue, per cent					
	Portland Cement A		Portland-Slag Cement B		Portland-Slag Cement C	
	Immediate Dilution[b]	5-min Predigestion[c]	Immediate Dilution[b]	5-min Predigestion[c]	Immediate Dilution[b]	5-min Predigestion[c]
EFFECT OF VARYING INITIAL AMOUNT OF WATER TO PRODUCE SLURRY, BEFORE ADDITION OF ACID						
5 ml of water added.....	1.18	1.03	0.66	[d]	0.53[e]	[d]
10 ml of water added[f]....	1.18	1.13	0.58	0.58	0.53	0.43
25 ml of water added.....	1.15	1.15	0.59	0.57	0.59	0.47
45 ml of water added.....	1.11	1.18	0.65	0.59	0.51	0.46
EFFECT OF VARYING FINAL ACID DIGESTION TIME AFTER DILUTION						
5 min digestion........	1.15	1.12	0.56	0.55	0.48	0.49
10 min digestion[f].......	1.16	1.07	0.70[e]	0.60	0.48	0.37
15 min digestion.........	1.18	1.13[e]	0.58	0.58	0.53	0.43
30 min digestion.........	1.08	1.04	0.56	0.52	0.55	0.42
60 min digestion.........	1.08	0.98	0.57	0.57	0.39	0.36
EFFECT OF VARYING SODIUM HYDROXIDE DIGESTION TIME						
0 min digestion.........	1.50	1.56	1.00	1.11	0.73	0.68
5 min digestion[f].......	1.29	1.17	0.56	0.58	0.58	0.43
15 min digestion.........	1.18	1.13	0.58	0.58	0.53	0.43
30 min digestion.........	1.13	0.99	0.59	0.56	0.48	0.48
60 min digestion.........	1.07	1.32[e]	0.60	0.63[e]	0.48	0.41

[a] ASTM procedure followed except for variations described. Except where indicated, values shown represent individual determinations.
[b] Immediate dilution to 50 ml after addition of acid.
[c] Digested for 5 min on hotplate before dilution to 50 ml.
[d] Separation of gelatinous silica made filtration impossible.
[e] Glassy fusion product noted in weighed residue.
[f] ASTM method. Average values taken from Table IV.

Results and Discussion

Effect of Variations from the Prescribed ASTM Conditions

Specific conditions required by the ASTM method were purposely varied in order to determine the effect of such variations on the results obtained. The variations and the results obtained are given in Table II. In this phase of the work, all digestions were conducted on an electric hot plate, and the dilution water and sodium hydroxide solutions were added at room temperature.

Initial Amount of Water.—The initial amount of water added to produce a slurry, prior to acid treatment, was purposely varied in order to determine its effect on the results obtained. In all cases, however, a final volume of 50 ml was maintained in accordance with the standard procedure.

From the values shown in Table II, it is apparent that this variation does not markedly affect the final result when the acid mixture is diluted immediately. However, when the acid solution is predigested before dilution, the results are slightly affected by this variation. As might be expected, predigestion in the more concentrated acid solution (least amount of initial water) gave the lowest values in the case of the portland cement. When the portland-slag cements were slurried with 5 ml of water, acidified, and predigested, large amounts of gelatinous silica separated and made the subsequent filtration impossible.

These tests indicate that the standard amount of water to produce a slurry (10 ml), is the minimum that should be used for both portland and portland-slag cements when the acid mixture is predigested prior to dilution. A significant decrease in this amount of water may produce low results in the case of portland cements, and might conceivably produce high results with portland-slag cements by causing gelatinous silica to separate. The tests further indicate that predigestion of the acid solution prior to dilution with water, produces lower insoluble residues in the case of high-manganese portland-slag cement C than when the mixture is diluted immediately. Such differences in results are not readily apparent in the case of the other two cements. This finding supports Note 2 in the ASTM method, which indicates that manganese constituents dissolve with difficulty in the diluted acid mixture.

Acid Digestion Time.—Somewhat lower values for both portland cement A and the high-manganese portland-slag cement C were obtained when the time of digestion in acid was increased. In both cements, predigestion generally resulted in lower values than were obtained when the test solution was diluted immediately. No difference was noted for cement B in either of these respects.

Alkali Digestion Time.—Increasing the alkali digestion time also produced lower values of insoluble residue for cements A and C. In the case of the portland cement, the effect of this variation appears to be more pronounced than that produced by varying the acid digestion time. The omission of the alkali digestion in its entirety, represented by "0 min digestion" in the table, was included in order to emphasize the effect of alkali digestion, *per se*, on this determination. Here again, predigestion produced lower values than did immediate dilution, except in the case of the low manganese portland-slag cement B, where no appreciable difference is apparent.

Effectiveness of Ammonium Chloride Washing to Remove Sodium Chloride

Several instances of abnormally high results are apparent in Table II. In most of these cases, it was observed that the weighed residues either contained or

consisted of dark glassy fusion products that were difficult to remove from the crucible. Such values are identified in the table by footnote *e*. Heretofore, it had been assumed that such occasional fusion products were characteristic of the cement tested. However, the erratic nature of its appearance in this study, and its association with unduly high results in Table II, suggested that the standard ammonium chloride washing procedure does not always effectively remove the sodium chloride. As a consequence, sufficient salt might remain to cause high values and fusion products.

Table III shows the amount of sodium chloride removed from the residue and filter paper by consecutive pairs of washings with hot ammonium chloride solution. The totals shown at the bottom of the table represent the minimum amount of sodium chloride (in mg) that would have remained to contaminate the residue had washing been discontinued after the twelfth washing (the minimum now specified). These results were obtained despite a deliberate effort to wash liberally and completely cover the residue and paper pulp with wash solution during each washing. It is quite likely that less attention to the detail of washing would have resulted in greater quantities of salt contaminating the residue after the twelfth washing. Since sodium chloride melts at 801 C and boils at 1413 C,[3] it is probable that a large part of the salt in the washed residue will remain unvolatilized during ignition, causing fusion and high results. From Table III, it appears that a minimum of 14 washings is necessary to insure that the amount of sodium chloride left on the filter paper is insignificant.

TABLE III.—EFFECTIVENESS OF FINAL WASHING WITH AMMONIUM CHLORIDE TO REMOVE SODIUM CHLORIDE.[a]

Filtrate from Washing	NaCl Found in Designated Filtrate, mg				
	Blank 1	Blank 2	Cement A	Cement B	Cement C
Nos. 7 and 8	>0.378	>0.378	>0.378	>0.378	>0.378
Nos. 9 and 10	0.348	>0.378	0.320	>0.378	>0.378
Nos. 11 and 12	0.148	0.098	0.106	0.356	>0.378
Nos. 13 and 14	0.064	0.052	0.046	0.068	0.166
Nos. 15 and 16	0.026	0.050	0.042	0.022	0.060
Nos. 17 and 18	0.056	0.022	0.042	0.042	0.050
Nos. 19 and 20	0.042	0.038	0.052	0.026	0.030
Nos. 21 and 22	0.038	0.022	0.046	0.030	0.042
Nos. 23 and 24	0.038	0.034	0.026	0.018	0.038
Total of 13 through 24	0.264	0.218	0.254	0.206	0.386

[a] Filtrates were analyzed for sodium by means of flame photometer.

Temperatures Attained by Various Methods of Digestion

From Table II it was concluded that the time of digestion in both acid and alkali was critical. Therefore, the temperatures maintained during digestion should also be critical. The standard method requires that the solution be digested for "15 minutes at a temperature just below boiling." However, various analysts and laboratories interpret these instructions somewhat differently. Some make use of an electric hot plate while others employ a steam bath for digestion. In addition, some analysts may add the dilution water and sodium hydroxide solution when at room temperature, while others preheat these reagents and add them while hot. Still another interpretation is the practice of heating the solution rapidly to a temperature just below boiling and maintaining that temperature for a full 15 min thereafter.

A few short studies were made to determine the temperature differences that might exist during digestion as a result of various interpretations. Figures 1 and 2 show the maximum temperatures attained by using the electric hot plate and steam bath located in this laboratory. Such digestion temperatures would be attained during a determination only when the reagents are preheated prior to use. The results indicate that there is a substantial difference between the temperatures maintained by the steam bath and those of the hottest zone of the hotplate.

Figure 3 illustrates the temperature change that might occur during a digestion when the reagents are added at room temperature. At the end of 15 min, it is obvious that the temperatures attained not only vary with the heating facility but are substantially below the boiling point of water.

From Figs. 1, 2, and 3, it appears that substantial differences can exist in the digestion temperatures, depending upon the analyst's interpretation of the standard procedure and the digestion equipment used. Steopoe has stated earlier that the insoluble residue values may vary greatly depending upon the duration and temperature of the alkali digestion.[4] Consequently, potential differences in temperature, of the order shown in this study, would be expected to affect the results significantly.

Rear

	91	94	96	92	91	90	
	93	97	98	98	97	92	
Left side	95	99	99	99[a]	98[a]	98	Right side
	95	97	97	95	95	95	
	90	91	95	92	94	90	

Front

Fig. 1.—Diagram showing maximum temperatures attained by water at various locations on electric hotplate, deg cent.

100 ml of distilled water in a 150 ml beaker.

[a] Temperatures rose to above 100 C when contents were not stirred continuously.

Rear

	86	85	
Left side	86	86	Right side
	85	86	

Front

Fig. 2—Diagram showing maximum temperatures attained by water at various locations on steam bath, deg Cent.

100 ml of distilled water in 150 ml beaker Porcelain rings with the two center rings removed.

Effect of Varying Conditions Not Specifically Prescribed by the Standard Method

In the final phase of this study, replicate determinations were made in order to show the effects of varying some of

[3] C. D. Hodgman, "Handbook of Chemistry and Physics," 31st ed., Chemical Rubber Publishing Co., Cleveland, Ohio (1949).

[4] A. Steopoe, Bulletin of the Roumanian Nat. Institute of Tech. Research, 3 (3 and 4) (1948) (in French); Anonymous, "Methods of Determining the Insoluble Residue of Cement." *Cement and Lime Manufacture*, Vol. 23 (1) 18–19 (1950) (English summary).

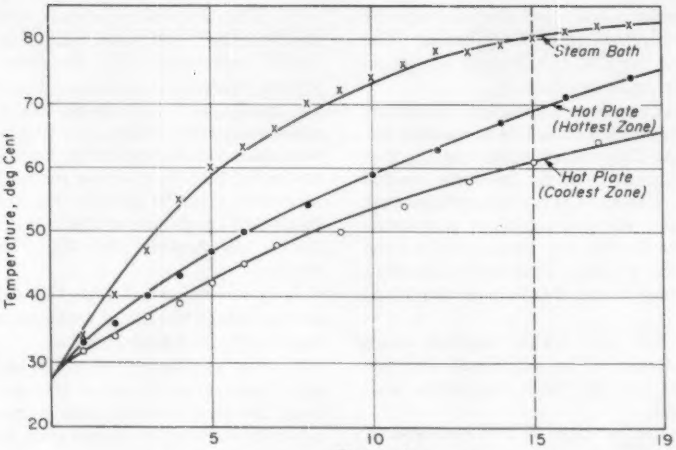


Fig. 3.—The increase in temperature for various methods of heating (starting with 100 ml of cold water in a 150 ml beaker.)

the conditions which are not rigidly controlled by the standard ASTM method. These results are shown in Table IV.

Dilution of the Acid Mixture.—As previously discussed, the ASTM method is not specific with respect to the time delay before diluting the acid mixture. The study of this variable was repeated but in a more exhaustive manner using replicate determinations.

As seen in Table IV, the findings are essentially the same as those shown earlier in the preliminary study. Predigestion of the sample before diluting the acid solution generally gave lower results than did immediate dilution. This difference is most apparent in portlant cement A and high-manganese portland-slag cement C. These findings are contrary to the general belief that failure to dilute the acid mixture rather quickly will result in positive errors as a result of the separation of gelatinous silica. For the reasons stated earlier, positive errors may result only when insufficient water is used to produce the initial slurry.

The low-manganese portland-slag cement B was not affected by this variable.

Heating Facilities for Digestion.—Table IV shows that, in the case of portland cement, steam bath digestion gave lower values than the hot plate under similar conditions of test. These results conform to what might be expected from a consideration of the temperatures attained by each method of heating (see Fig. 3). No pronounced differences were noted for the two portland-slag cements.

Hot Reagents and Increased Washing.—Table IV shows that the use of preheated reagents and increased final washing resulted in lower values for the insoluble residue than were obtained by any of the other variations studied. These conditions also yielded the most reproducible results, as indicated by the mean deviations. It is likely that the increased reproducibility resulted from the more complete removal of sodium chloride by extended washing. It was observed that no glassy fusion products were present in the ignited residues obtained by this variation.

Overnight Drying of First Residue.—It was suspected that still another variable permitted by the present method could account for nonuniform results. Some laboratories permit the residue obtained from the acid digestion to air-dry on the filter paper either overnight or longer, prior to the alkaline digestion. It was thought that such delay might sufficiently dehydrate any gelatinous silica, if present, to reduce its solubility in the subsequent alkaline digestion. Accordingly, the first residue from each cement was allowed to dry overnight on filter paper, prior to alka-

TABLE IV.—COMPARISON AND REPRODUCIBILITY OF INSOLUBLE RESIDUE VALUES OBTAINED BY PERMISSIBLE VARIATIONS WITHIN THE STANDARD METHOD.

		Insoluble residue, per cent								
		Portland Cement A			Portland-Slag Cement B			Portland-Slag Cement C		
		Federal Method[a]	ASTM Method[a]	ASTM Method[b]	Federal Method[a]	ASTM Method[a]	ASTM Method[b]	Federal Method[a]	ASTM Method[a]	ASTM Method[b]
Reagents at room temperature Final washing in accordance with standard method (12 to 15 times)	Digestions on electric hotplate		1.21	1.12		0.62	0.56		0.59[c]	0.41
			1.21	1.18		0.56	0.62		0.56	0.44
		...	1.14	1.11	...	0.60	0.57	...	0.49	0.50[c]
			1.14	1.11		0.55	0.58		0.51	0.37
			1.21	1.11		0.58	0.56		0.50	0.45
	Average	...	1.18	1.13	...	0.58	0.58	...	0.53	0.43
	Difference (high-low)	...	0.07	0.07	...	0.07	0.06	...	0.10	0.13
	Mean deviation	...	0.03	0.02	...	0.02	0.02	...	0.04	0.04
	Digestions on steam bath		1.09			0.57			0.45	
			1.18			0.59			0.48	
		...	1.09	...	...	0.63	...	...	0.65[c]	...
			1.08			0.58			0.52	
			1.20[c]			0.63			0.49	
	Average	...	1.13	...	...	0.60	...	...	0.52	...
	Difference (high-low)	...	0.12	...	...	0.06	...	...	0.20	...
	Mean deviation	...	0.05	...	...	0.02	...	...	0.05	...
Reagents added hot Final washing 20 to 24 times)	Digestions on electric plate	1.08	1.07	0.99	0.55	0.58	0.55	0.51	0.44	0.36
		1.05	1.11	1.01	0.54	0.57	0.56	0.41	0.42	0.37
		1.01	1.08	1.06	0.54	0.56	0.54	0.42	0.46	0.42
		1.07	1.11	1.00	0.55	0.56	0.56	0.42	0.43	0.41
		1.04	1.03	1.01	0.56	0.56	0.53	0.54	0.45	0.36
	Average	1.05	1.08	1.01	0.55	0.57	0.55	0.46	0.44	0.38
	Difference (high-low)	0.07	0.08	0.07	0.02	0.02	0.03	0.13	0.04	0.06
	Mean deviation	0.02	0.02	0.02	0.01	0.01	0.01	0.05	0.01	0.02

[a] Immediate dilution to 50 ml after addition of acid.
[b] Digest for 5 min on heating facility before dilution of acid solution.
[c] Glassy fusion product noted in weighed residue.

line treatment. The conditions selected were the same as part 2 in Table IV, employing the 5-min predigestion treatment, to favor the conditions that would most likely produce gelatinous silica. The results obtained are not shown in the table, but were as follows: cement A 1.00 per cent, cement B 0.58 per cent, and cement C 0.36 per cent. These results are in close agreement with the average of those obtained without this variation, that is, 1.01 per cent, 0.55 per cent, and 0.38 per cent, respectively. Consequently, it was concluded that overnight delays in making the alkaline digestion did not cause unusual results.

Comparison of Federal with ASTM Procedure

As shown in Table IV, the Federal procedure gave substantially the same results as the ASTM procedure when immediate dilution was utilized in the latter case. Under these conditions, the only procedural difference that existed between these methods was in the composition of the final wash solution. It was observed, as suggested by Bean,[5] that the filter papers washed with ammonium nitrate as required by the Federal procedure could be charred and ignited much more rapidly than those washed with ammonium chloride as required by the ASTM procedure. In this respect, the Federal method has a distinct advantage over the ASTM method.

The results obtained by the two methods were not the same in all cases when a predigestion period was employed in the ASTM method. In these instances the ASTM procedure gave lower results than did the Federal procedure. No significant differences were noted for the portland-slag cement with low manganese content.

Conclusions and Recommendations

On the basis of the cements studied and the results shown, it appears that significantly different values may be obtained in the insoluble residue determination, depending upon the analyst's interpretation of the present ASTM procedure. More specific requirements are needed to increase the reproducibility of the test results. Specific conclusions and recommendations regarding the ASTM method are as follows:

1. The use of less than 10 ml of water to produce the initial slurry can cause low results in a portland cement and possibly high results in a portland-slag cement. The latter situation may arise as a result of the separation of gelatinous silica, when the acid mixture is predigested prior to dilution. The present ASTM requirement of 10 ml appears to be satisfactory

However, from a practical laboratory standpoint, it is desirable to conduct the SO_3 (ASTM) determination on the first acid filtrate from the insoluble residue test. Therefore, it is recommended that the same solution procedure now specified for the SO_3 test be adopted for the insoluble residue. This method specifies the use of 25 ml H_2O to form the initial slurry.

2. Acid and alkali digestion times were found to be significant and the present ASTM time limitations well justified.

3. Predigestion of the cement-acid solution for 5 min prior to dilution generally gave lower values than did immediate dilution. This difference was significant in the case of the portland cement with a high insoluble residue as well as the portland-slag cement of high manganese content. It is also concluded that the predigestion procedure does not result in the separation of gelatinous silica and consequent high values when at least 10 ml of water is used to form the initial slurry.

The ASTM procedure could be made to conform more closely to the Federal method by the requirement of immediate dilution. However, such a stipulation is not considered sufficient in all cases to dissolve satisfactorily the manganese compounds that may be present. Therefore, it is recommended that the present ASTM requirement of predigesting when necessary be retained.

4. Differing results are obtained depending upon whether the analyst dilutes with cold water and initiates digestion with cold sodium hydroxide, or whether these reagents are preheated prior to use.

It is recommended that the ASTM procedure specify the use of "hot water" to dilute the acid mixture and the addition of "hot" sodium hydroxide. It is also recommended that immediately after dilution, the acid solution be heated rapidly to a point just below boiling and that the digestion period of 15 min be measured from the time this temperature is reached.

5. Glassy fusion products often observed in the ignited residues may cause significant positive errors and are a consequence of inadequate washing of the final residue.

It is recommended that the present procedure be modified in this respect and require a minimum of 14 washings. It is further suggested that the method require that each individual washing be sufficient to wash completely the filter paper and its contents.

6. The Federal procedure yielded approximately the same results as the ASTM procedure, when the latter involved immediate dilution. However, the results were not comparable in all cases when predigestion prior to dilution was utilized in the ASTM procedure. It was noted that the charring and removal of carbon prior to ignition was greatly facilitated by the use of the ammonium nitrate as required by the Federal method.

It is recommended that the ASTM method adopt the use of ammonium nitrate in the final wash solution

7. No significant difference in results was obtained when the residue from the acid digestion was purposely allowed to air-dry overnight prior to the alkaline digestion.

EDITOR'S NOTE.—In connection with the data presented in this paper, the Working Committee on Methods of Chemical Analysis of ASTM Committee C-1 on Cement has proposed a revision of the insoluble residue determination in portland cement, ASTM Method C 114 - 53, Section 28, as follows:

Insoluble Residue[9]

Procedure:

28(*a*). To 1 g of the sample (Note 1), add 25 ml of cold water. Disperse the cement in the water and while swirling the mixture, quickly add 5 ml of HCl. If necessary, warm the solution gently and grind the material with the flattened end of a glass rod for a few minutes until it is evident that decomposition of the cement is complete. (Note 2) Dilute the solution to 50 ml with hot water (near boiling) and heat the covered mixture rapidly to near boiling by means of a high-temperature hot plate. Then digest the covered mixture for 15 min at a temperature just below boiling. (Note 3) Filter the solution into a 400 ml beaker, wash the beaker, paper, and residue thoroughly with hot water, and reserve the filtrate for the sulfur trioxide determination, if desired. (Note 4) Transfer the filter paper and contents to the original beaker, add 100 ml of hot (near boiling) NaOH solution (10 g per liter) and digest at a temperature just below boiling for 15 min. During the digestion, occasionally stir the mixture and attempt to macerate the filter paper. Acidify the solution with HCl using methyl red as the indicator and add an excess of 4 or 5 drops of HCl. Filter and wash the residue at least 14 times with hot NH_4NO_3 solution (20 g per liter) making certain to wash the entire filter paper and contents during each washing. Ignite the residue in a tared crucible at 900 to 1000 C, cool in a desiccator, and weigh.

NOTE 1.—(Same wording as present Note 1.)

[5] Bean, B. Leonard, Chemist, National Bureau of Standards, Washington, D. C. Private communication.

[9] Same as presently written, except change "NH_4Cl" to "NH_4NO_3."

Note 2.—(Same wording as present Note 2.)

Note 3.—In order to keep the solutions closer to the boiling temperature, it is recommended that these digestions be carried out on an electric hot plate rather than on a steam bath.

Note 4.—Continue with the sulfur trioxide determination (Section 16 or 44) by diluting to 250 or 200 ml as required by the appropriate section.

28 (*b*) (Same as presently written.)

28 (*c*) *Calculation.*—Calculate the percentage of the insoluble residue to the nearest 0.01 by multiplying the weight of the residue (corrected for the blank) in grams by 100.

Discussion of Paper on Creep of Glass-Reinforced Plastics[1]

MR. WARD F. SIMMONS.[2]—The author has attempted to calculate the creep properties of glass-reinforced plastic laminates from their short-time tangent modulus properties, and in doing so he has used data obtained at Battelle Memorial Inst. for Wright Air Development Center and reported in *USAF Technical Report No. 6172*, May 31, 1950. In his discussion, he made the following statement: "Only one report (*USAF Technical Report No. 6172*) was found to have the required information, and then in sketchy form. A large part of the data could not be used because of obvious inaccuracies. These inaccuracies consisted for the most part in decreases in observed creep with increases in applied stresses and temperatures. It should have been the other way around."

If a material is stable within a given temperature range, for example, 80 to 500 F, its creep resistance can be expected to decrease with increase in temperature or stress as indicated by the author. However, plastic-glass laminates, particularly those fabricated with thermosetting resins, are not stable materials. They may continue to cure during creep testing, and their creep resistance or rupture strength may be greater at 300 or 400 F than it was at 80 F. The accompanying Figs. 3 and 4[3] show creep-rupture curves for Bakelite BV-17085 phenolic-resin glass-fabric laminate in tension and compression for times out to 1000 hr. Notice that the rupture strength at 300 F in tension is greater than that exhibited by other specimens of the same material at 80 F. Also, the creep-rupture data at 500 F indicate that for 60 hr this material was stronger at 500 F (in tension) than it was at 80 F. In compression, Fig. 4, the behavior was more conventional, with the rupture strengths decreasing with an increase in temperature.

The curing cycle for panel 3 of this material was as follows:

(*a*) Resin precure: 5 min at 260 to 278 F
(*b*) Press cure: 1 hr at 320 to 340 F and 200 to 250 psi

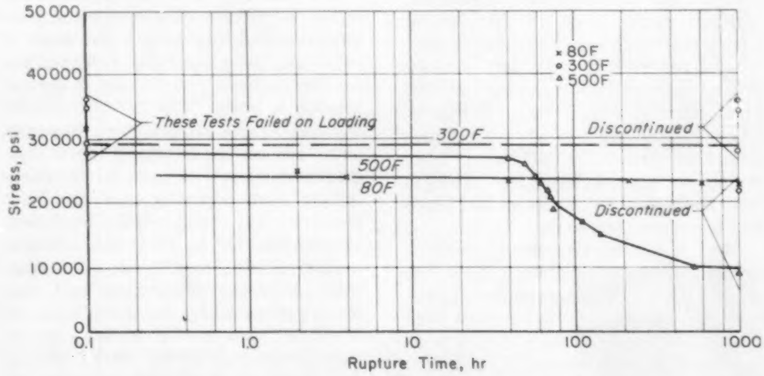


Fig. 3.—Stress *versus* rupture time curves for Bakelite BV-17085 phenolic resin-glass fabric laminate in tension at 80, 300, and 500 F.

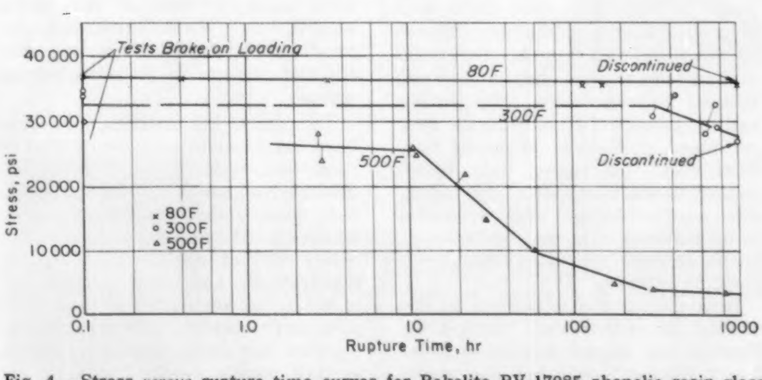


Fig. 4.—Stress *versus* rupture time curves for Bakelite BV-17085 phenolic resin-glass fabric laminate in compression at 80, 300, and 500 F.

[1] Solomon Goldfein, "Creep of Glass-Reinforced Plastics," ASTM BULLETIN, No. 225, Oct., 1957, p. 29 (TP179).

[2] Metallurgist, Battelle Memorial Inst.

[3] "Room- and Elevated-Temperature Strength Properties of Bakelite BV-17085 Glass Fabric-Plastic Laminate," *WADC Technical Report 57-531*, Battelle Memorial Inst., June, 1957.

(c) Postcure:

Time, hr	Temperature, deg Fahr
16	200
2	250
2	300
2	350
1	400
16	325

Under certain conditions, plastic-glass laminates exhibit considerable scatter of creep or creep-rupture test data. In tension at 300 F, the creep-rupture specimens in Fig. 3 either failed on loading or lasted for 1000 hr. One specimen failed on loading at 29,300 psi while another, at 35,900 psi, was discontinued after 1000 hr. The magnitude of the deviations from what might be considered the normal behavior for a stable material are greater in Fig. 3 than the "obvious inaccuracies" referred to by the author in *AFTR No. 6172*.

Creep-rupture behavior of the type illustrated in Figs. 3 and 4 is not uncommon for plastic-glass laminates (we have observed it in at least five different materials). These laminates often exhibit their greatest creep-rupture strength at temperatures above room temperature, and since both curing and ultimate deterioration of the resin at high temperatures are time-temperature dependent, the properties may decrease precipitously after some given time (60 hr at 500 F in Fig. 3, 10 hr in Fig. 4). These characteristics of plastic-glass laminates cannot be neglected when trying to predict long-time strength from short-time properties as Mr. Goldfein has attempted to do.

MR. SOLOMON GOLDFEIN (*author's closure*).—In demonstrating how the creep properties of glass-reinforced plastic laminates could be determined from modulus of elasticity data at high temperatures, reliable modulus data were naturally required.

Anyone who has attempted to use experimental data published in the literature will agree that there is a large amount of such data from different sources which do not agree. Very often examination of such data will reveal internal inconsistencies. The author had no intention of deprecating the work performed at Battelle Memorial Inst. from which his papers were based. Rather, he was overjoyed at discovering some reliable data upon which to base his work, and was chagrined to find that not enough were present to make a complete presentation.

In discussing the limitations of the method of determining "Long-Term Rupture and Impact Stresses in Reinforced Plastics" published the month previously in the September, 1957 issue of the ASTM BULLETIN which was a companion piece to the one on creep in the October, 1957 issue, it was stated that, "the relationship could not obviously be considered for use with an incompletely cured thermosetting resin, since the conditioning and testing of the material at elevated temperatures would amount to a post cure." Perhaps the statement should have been repeated in the later paper since, in the author's opinion, it applies equally well to it.

Obvious also is the fact that the relationship could not be used with materials which are internally unstable. The author maintains that none of the resins tested and reported in *USAF Technical Report 6172* fell into that category.

Strong exception must be taken to the accuracy of the assertion that "plastic-glass laminates, particularly those fabricated with thermosetting resins, are not stable materials." There are too many cases on record which indicate that when properly fabricated, these materials are very stable. The polyester and epoxy resin data used in my two papers cited here are just a few of the many which could be used to support this statement.

The stability of thermosetting laminates is relative. The higher the temperature and the longer the time of exposure, the greater the potentialities are for continued crosslinking, molecular scission or both. The law of diminishing returns sets in very early, however, since spatial relationships, steric hindrance, etc., prevent much further crosslinking from occurring once the basic network has been well developed. Breakdown due to molecular scission, oxidation, etc., may occur on a large scale above the temperature and time limits prescribed by the manufacturers. We have been careful to keep within these limitations in our work, keeping the effects of these phenomena to an insignificant minimum.

It is possible that Mr. Simmons is using the word "unstable" here in the sense that there is some unknown characteristic of the material which causes it to act and perform in an unengineering manner.

To support his assertion, Mr. Simmons has chosen to demonstrate what he considered, evidently, to be a typically unstable laminate, a BV-17085 phenolic-resin glass-fabric laminate. Evidence was presented indicating a cure cycle in excess of that recommended by the manufacturer, and a postcure sufficient to lay to rest any doubts as to its complete polymerization. Nevertheless, he reported that the laminate exhibited its greatest tensile rupture strengths at temperatures above room temperature rather than the reverse. As a result, he concluded that the laminate was unstable.

The evidence which he presented, however, does not support his conclusion. Figure 4, showing rupture stress *versus* time for the laminate in compression appears to be a well conducted series of tests. True, there are perhaps a few too many evidences of scattering in some portions of the 300 and 500 F curves, but these do not change the situation significantly. What is important is that the temperature curves are in the correct positions. Since the compressive properties of a laminate are primarily a function of the plastic component, it must be concluded that the plastic is stable within the limits of the conditions of the tests. Thus the laminate is quite stable in compression. Figure 3, on the other hand, shows exceptionally large scattering of tension test data in the 300 F test. The correct curve could be almost anywhere between the points presented. The author believes that the 80 F curve is misplaced. If it were above the 300 F curve, there could be no cause to label the laminate unstable. No data were presented as to the source of individual test specimens, that is, which laminates they came from, variation in the short-time properties obtained during the acceptance tests, glass concentrations, etc. Casual evaluation of the data might condemn the laminate as being unstable.

Is it logical to conclude, then, that in the case of the compressive properties, BV-17085 was well cured and chemically and physically stable in a glass laminate, but was unstable chemically or physically in the same identical laminate when considered in the light of its tensile properties? I think not. Stress analysis shows that compression includes elements of tension. If there were anything wrong with the tensile properties of a material, it would show up in testing its compressive properties. We have come across similar anomalies in our laboratory many times and have found that only meticulous care in every detail from lay-up to fabrication, sampling, testing, and evaluation produced consistent results continuously. We can only conclude that the reasons for inconsistencies in the tensile behavior of the BV-17085 laminate must be sought elsewhere than in the plastic component.

In essence, Mr. Simmons is trying to say that since glass laminates are unstable their long-term properties cannot be predicted. I have shown, however, both in the paper on rupture stress and this one on creep, that these properties can be predicted. The results speak for themselves.

Methods for Rating Concrete Waterproofing Materials

by F. KOCATASKIN and E. G. SWENSON

In an attempt to develop reliable test methods for evaluating the effectiveness of concrete waterproofers, it was found that a combination of saturated and unsaturated permeability tests is necessary, the latter covering more than one humidity condition

THE USE OF waterproofing admixtures or surface treatments for mortars and concrete has become widespread in recent years. Although the benefits to be derived from their use are questioned by many concrete experts, there has been no serious attempt to develop separate methods for rating the effectiveness of these materials for each of the various conditions that can exist in the field.

Waterproofing admixtures or surface treatments have been mainly associated with prevention of liquid flow through concrete. The prevention of dampness and the stopping of rain penetration are also claimed for many materials. Of added interest is the possible effect of such agents in reducing efflorescence, staining, and frost damage on exposed mortar or concrete.

The problems involved in properly evaluating these materials concern: (*a*) the various types of moisture situations; (*b*) the various types of waterproofing materials on the market; (*c*) the variation in the constituents and composition of the concrete; (*d*) the reactions of waterproofing materials with different cements; and (*e*) the influence of waterproofing materials on other properties of the concrete, such as strength and durability. Comprehensive investigations with integral or surface waterproofing materials involve mainly tests with water pressure and absorption (**1,2,3,4,5,6**).[1] But the development of a reliable test procedure involving all possible problems has not appeared in the literature. The present investigation was therefore undertaken to serve as a basis for the establishment of a simple but satisfactory series of test methods.

Initial Considerations

Structure of Concrete and Nature of Moisture Flow

Hardened concrete is a solid containing a gel pore system, an aggregate pore system, both usually very fine, and a cement-paste pore system that varies with water-cement ratio, degree of compaction, degree of hydration, and type of cement. Aggregate pores and gel pores play only a minor role in the transport of moisture. The cement paste pores are scattered capillary pockets and channels, some isolated, some interconnected. Their size varies from very fine to very large. They are responsible for the degree of permeability of concrete (**7,8**).

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E. G. SWENSON, associate research officer, Materials Section, Division of Building Research, National Research Council of Canada, and formerly assistant professor in chemistry at the University of Saskachewan, is currently in charge of cement and concrete research and the author of several papers in this field.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the authors. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

Under isothermal conditions water may be transferred through this porous system by vapor flow for low moisture contents and by liquid flow for saturated conditions. For partially saturated conditions both mechanisms are believed to operate simultaneously.

Under nonisothermal conditions these situations may be complicated by the influence of temperature gradients between different parts of the concrete. They may be further complicated by osmotic pressures or electrical potentials. In the present study, however, these additional effects as well as other accidental means for water transfer through concrete, such as cracks, honeycombing, and joints, will not be taken into consideration.

Theory of Moisture Flow

The theory of moisture flow in porous media has been developed in analogy with heat transfer (**9,10,11**). It uses the concept of potential and the general equation of flow is given for the one dimensional case as:

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial x}\left[K(\psi)\,\frac{\partial \psi}{\partial x}\right] \quad \text{.......(1)}$$

where:

θ = the moisture content at point x, at the time t,

ψ = the moisture potential at point x, at the time t, and

$K(\psi)$ = the permeability function.

The potential ψ represents the specific free energy of the moisture. For practical application it may be expressed either in terms of hydraulic pressure P or in terms of vapor pressure p, as convenience demands.

A direct solution of the general flow equation is not possible, and it is necessary to determine experimentally the function $K(\psi)$, relating permeability to moisture potential.

In the case of steady-state flow, the general equation is simplified, can be integrated once, and takes the form:

$$q = K(\psi)\,\frac{d\psi}{dx} \quad \text{..........(2)}$$

For the saturated steady-state flow this is the well-known Darcy's formula:

$$q = K\,\frac{\Delta P}{\Delta x} \quad \text{..........(3)}$$

For the unsaturated steady-state flow, and regarding vapor pressure as the potential:

$$q = K(p)\,\frac{dp}{dx} \quad \text{..........(4)}$$

In the case of transient flow only simple problems like capillary absorption or drying by evaporation can be solved with certain assumptions. For capillary absorption, for instance, assuming:

$$\theta = \gamma\cdot\epsilon\cdot x, \qquad K(\psi) = K,$$

$$\frac{\partial(\partial\psi/\partial x)}{\partial/x} = \frac{f}{x}$$

where:

γ = density of water,

ϵ = porosity of the medium, and

f = suction force,

the equation may be integrated and the well-known capillarity formula obtained:

$$\gamma\cdot\epsilon\cdot\frac{dx}{dt} = K\cdot\frac{f}{x}, \qquad \gamma\cdot\epsilon\cdot x^2 = 2K\cdot f\cdot t,$$

$$\theta^2 = (2\gamma\cdot\epsilon\cdot K\cdot f)t = K_c t \quad \text{.....(5)}$$

The coefficient K_c, known as the capillarity-coefficient, is a function of the porosity, permeability, and suction of the medium. Therefore it is not a constant; it depends upon the initial moisture condition of the medium.

These considerations show that the effects of material properties upon moisture flow may be reflected through the coefficients K, $K(p)$, and K_c. For correct evaluation of integral or surface waterproofing materials on the basis of their effectiveness in decreasing the flow of moisture in concrete, it is necessary to study their influence on these coefficients for the whole range of the variation of the latter. The usual hydrostatic flow test or the simple absorption test would appear to be insufficient. It is clear that proper evaluation can be achieved only by a series of tests to cover the various situations that can occur.

Selection of Waterproofing Materials and Preparation of Test Specimens

From commercially available groups, four integral and three surface waterproofing materials were selected as representative:

Admixture 1—Accelerator type (calcium chloride solution).
Admixture 2—Water-repellent type (ammonium stearate paste).
Admixture 3—Bituminous emulsion.
Admixture 4—A paste of siliceous and organic composition.
Surface waterproofing material 1—Cement grout (water-cement ratio, 0.75).
Surface waterproofing material 2—Cement base paint (water-paint ratio, 0.75).
Surface waterproofing material 3—Silicone resin solution (5 per cent silicone).

A type I Canadian cement was used. It is referred to as cement X.

Two mortar compositions were selected: mortar A was fairly rich and with a low water content; mortar B was a lean mix with a high water content. The sand used was one which has a good service record. Its specific gravity in the saturated surface-dry condition was 2.6. Separate sieve sizes were blended to give the following percentages passing each sieve size (the latter in parentheses: 100 per cent (No. 4), 80 per cent (No. 8), 60 per cent (No. 16), 35 per cent (No. 30), 15 per cent (No. 5), 5 per cent (No. 100), and 0 per cent (pan). Table I gives the proportions of the mixes as used in the test specimens.

TABLE I.—MIX PROPORTIONS USED IN TEST SAMPLES.

Constituents	Mix A	Mix B
Aggregate-cement ratio (weight)	6.17:1	7.44:1
Water-cement ratio (weight)	0.62:1	0.78:1
Density of fresh mortar, g per liter	2340	2300
Cement content, g per liter	300	250
Sand content, g per liter	1855	1855
Water content, g per liter	185	195
Air content, per cent by volume	1.6	2.2

Preparation of test specimens was as follows:

(*a*) *Specimens With Integral Waterproofing Materials.*—Small cylindrical specimens 4 in. in diameter and 1 in. thick were made from these mixes, with and without each of the selected admixtures. Additional specimens were made for supplementary tests for compressive strength, tensile strength and shrinkage, according to ASTM standards.[2] All specimens were cured in near 100 per cent relative humidity conditions at 23 C, demolded, stored in water for 6 days, then placed in a room conditioned at 50 per cent relative humidity and 23 C to the age of 28 days. Identification of the specimens was provided by a code, the first letter referring to the mortar, the number to the admixture, and the third letter to the cement, for example A0X, A1X, etc. Where the middle term is zero no admixture was used. Duplicate specimens were used for each test and their mean values are reported throughout.

(*b*) *Specimens With Surface Waterproofing Materials.*—All surface waterproofers are intended to be painted on surfaces with smooth textures and without large pores. Since mortar A met these requirements, it was used in these tests. The size, shape, preparation, and curing of the specimens were the same as for the series containing integral waterproofing materials. Surface waterproofings were applied at the age of

[2] Tentative Method of Test for Compressive Strength of Hydraulic Cement Mortars (Using Portions of Prisms Broken in Flexure) (C 349-54 T), 1955 Book of ASTM Standards, Part 3, p. 136. Method of Test for Tensile Strength of Hydraulic Cement Mortars (C 190-49), 1955 Book of ASTM Standards, Part 3, p. 188.

28 days on one face of the specimens. After this the specimens were cured an additional 14 days at 50 per cent relative humidity before tests were started. For identification, a letter-number code was used, the letter indicating surface, the number referring to the waterproofer, for example, S0, S1, S2, etc. The case of S0 means that no waterproofer was applied.

Experiments and Results

Specimens with Integral Waterproofing Materials

The Unsaturated Permeability Test.—In this investigation unsaturated permeability refers to the case where moisture flow occurs as the result of an appreciable vapor pressure gradient in the material. The degree of unsaturation would naturally be different for different conditions of test. The usual dry-cup procedure for measuring the vapor permeance of building materials (**12,13**) was found suitable for measuring unsaturated permeability and was adopted with slight modification to accommodate the relatively thick specimens. The specimens were mounted on aluminum dishes, which were filled with a desiccant (calcium chloride) and the sides sealed with wax. These dry cups were stored in chambers in controlled constant temperature and constant humidity conditions. Owing to the difference of vapor pressures outside (p) and inside ($p_0 = 0$), moisture diffused through the pores of the mounted specimens into the dish and was taken up by the desiccant. At steady-state conditions the rate of moisture flow, q, was determined from the weight gains of the dish. It may be noted that by storing several dry cups in different humidity conditions p, corresponding values of q could be determined.

The law of vapor permeability previously given as

$$q dx = K(p) dp$$

can be expressed, with q = constant for the steady-state flow, as

$$qx = \int_0^p K(p) dp \quad \ldots\ldots\ldots (6)$$

But it is not possible to carry out the integration without knowing the function $K(p)$. However, as it was possible to obtain values of q for given values of p experimentally by the dry-cup test, these experimental values of q, if multiplied by x, plotted against p, and connected by a smooth curve would represent the $\int_0^p K(p) \cdot dp$ function. By graphical differentiation, it is possible then to derive the unknown permeability function $K(p)$.

To determine the influence of admixtures on the unsaturated permeability of concrete, duplicate specimens from all control and test series were tested by the dry-cup method at 50, 80, and 100 per cent relative humidities. Figure 1 shows the permeability functions obtained by the graphical differentiation method from results of these tests. As seen from Fig. 1, admixtures 1 and 4

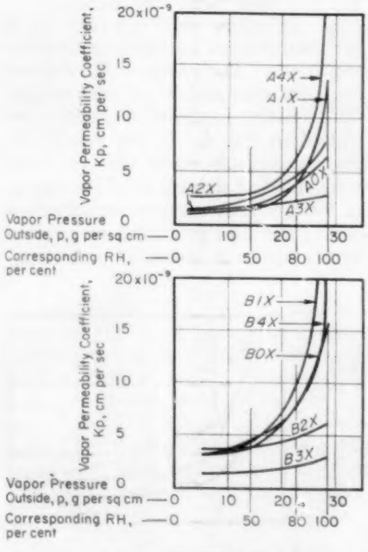

Fig. 1.—Vapor permeabilities of mix A, with and without admixtures.

NOTE.—A in first graph refers to the rich mix with low water cement ratio. B in second graph refers to the lean mix with high water-cement ratio. The middle numbers refer to the admixtures, the zero term indicating no admixture (reference). The last term, X, refers to the cement used.

were not effective; they increased the permeability. Admixture 2 was effective in one mix, and admixture 3 in both mixes. In this and the following graphs the data points are not shown for any of the curves since the results are based on proprietary materials the exact compositions of which are not known. The curves should therefore be interpreted in a qualitative way. For this reason also much of the data is not included in this paper.

A special case of unsaturated permeability will be obtained when a concrete is subjected to liquid water on one surface and to free air on the other surface. Dense concretes with their extremely fine pores offer such a great resistance to liquid flow that the concrete will dry out by evaporation to the air and a condition of partly saturated and partly unsaturated permeability will occur (**14**). The flow will be influenced by both the coefficients of saturated and unsaturated permeabilities. As results of investigations show, however, most integral waterproofing materials have no appreciable effect on the first coefficient (saturated permeability). Therefore, the function of the second coefficient $K(p)$ (unsaturated permeability) is also expected to reflect the effects of integral waterproofing materials for this special case of composite permeability. Experimental evidence was provided by a series of so-called inverted wet-cup tests, in which specimens of each series were mounted on aluminum dishes, as for the vapor permeability test. The dishes were filled with 1 to 2 in. of water, the sides sealed with wax and the dishes inverted, bringing the water to the top of the specimens. Pairs of these inverted wet cups were stored in still air at 50 per cent relative humidity, leaving their bottom surfaces free for evaporation. After steady-state conditions were reached, rates of moisture flow were determined from weight losses of the dishes. The results, not recorded here, were closely similar to those on Fig. 1 on vapor permeability.

The Saturated Permeability Test.—In this study saturated permeability refers to the case where moisture flow occurs as the result of a hydrostatic pressure gradient in a specimen in which the degree of saturation is determined by the condition of test. Apparatus suitable for determining saturated permeability under a small head has been described elsewhere (**15,16**). The basic apparatus used in the present study is shown schematically in Fig. 2. To

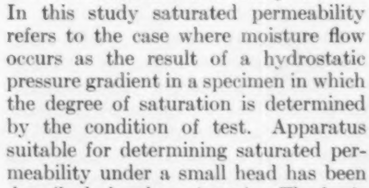

Fig. 2.—Saturated permeability apparatus.

avoid the complications introduced by evaporation at the exposed face, the apparatus was stored in a room controlled at near 100 per cent relative humidity and 23 C. The apparatus was designed to maintain a constant hydraulic head on the specimen by means of a horizontal capillary tube, and to allow measurement of flow into the specimen through observation of the miniscus in the capillary tube. Measurements were begun when droplets became visible at the exposed surfaces and were taken each day for one week.

Experimental results show that if the conditions producing flow are maintained over a substantial period, there is a continuous decrease in the permeability of the concrete. Explanations have been given in terms of expansion of cement particles due to further hydration, swelling of the cement and aggregate colloids due to wetting, clogging of the pores by products of the chemical combination of bicarbonates in water with the free lime of cement, retardation of flow due to the establishment of an electrical potential, retardation of flow due to osmotic pressures, etc. For practical purposes, it seemed sufficient to follow this change in permeability up to seven days, at which time it became practically constant.

Duplicate specimens from all control and test series were tested for saturated permeability under the conditions described above. The permeability coefficients calculated from the rates of flow using Darcy's formula are plotted in Fig. 3 against time, using semilogarithmic coordinates for convenience. Before comparing the results obtained from test series with those obtained from control specimens, it was necessary to know how much variation was to be expected between specimens of the same composition, but prepared from different batches. Therefore, additional duplicate specimens were prepared from additional batches of mixes A0X (rich mix) and B0X (lean mix), and these were tested for permeability in the same manner. The results of these additional series are shown in Fig. 3 as curves A0XR and B0XR. (These batches of the same composition were carried out to check reproducibility.)

Comparing the results, it is seen that permeabilities from all test series fall within the range of their control mixes. Thus none of the admixtures has shown any markedly beneficial properties. This result is in essential agreement with the conclusions reached by other investigators.

The Capillary Absorption Test.—No special apparatus was needed for this test. The specimens were stored until equilibrium was reached at 50 per cent relative humidity and then weighed and set in contact with water from one surface. The amount of absorption was measured by taking weights at intervals. The square of the weight gain was plotted against time to give straight lines of the form:

$$\theta^2 = K_c \cdot t + a$$

It was assumed that a represented the first amount of water necessary to wet the surface. The slopes, K_c, of these straight lines were determined. The same procedure was repeated for 0 per cent relative humidity equilibrium conditions. The values of K_c obtained for 0 per cent and 50 per cent equilibrium relative humidity conditions are plotted in Fig. 4. It was possible to draw a suitable curve through these two points and through the $K_c = 0$ point at 100 per cent relative humidity, assuming the same general shape as given for absorption isotherms of porous materials, and thus obtain the whole variation of the capillarity coefficient. The thickness of the specimens was shown to influence the results of the capillary absorption test. Therefore the tests were not prolonged beyond the appearance of the first wet spots on the opposite surfaces of the specimens.

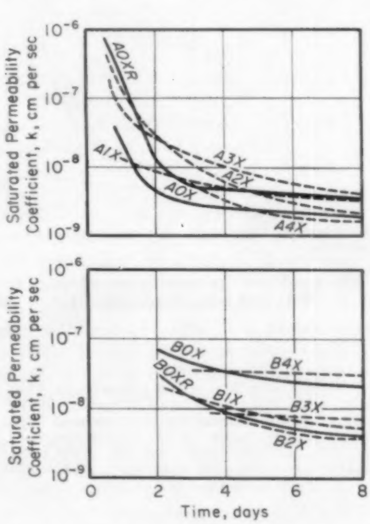

Fig. 3.—Saturated permeabilities of mixes A and B, with and without admixture.

To investigate the influence of waterproofing admixtures, duplicate specimens from all test and control series were tested in the described manner. Figure 4 shows the curves of capillarity coefficients obtained. Admixture 1 is shown to have no effect on capillarity. Admixtures 2 and 3 were very effective in reducing capillarity; admixture 4, however, gave higher absorption values.

Additional Tests.—Certain properties of the cement and mortars, other than permeability, were expected to be modified by the admixtures. Several supplementary tests were made to check such effects, and their results may be summarized as follows:

(*a*) The calcium chloride admixture accelerated the setting time of the standard cement paste very considerably (initial set 55 min, final set 70 min); the other admixtures did not affect the set (initial set 180 to 220 min, final set 230 to 285 min).

(*b*) The workability of the mortar, as measured by the time of vibration necessary for complete compaction, was improved by the stearate admixture; the calcium chloride or siliceous admixtures did not affect workability; the bituminous emulsion gave very poor workabilities;

(*c*) The 28-day compressive strengths were not significantly affected by the calcium chloride, stearate, and siliceous admixtures; the bituminous emulsion decreased the compressive strength by 20 per cent.

(*d*) The 28-day tensile strengths were not affected by the calcium chloride and stearate admixtures; the bituminous and siliceous admixtures, however, improved tensile strengths considerably, 315 and 310 psi, respectively, as compared with 231 psi for the mix containing no admixture.

(*e*) Shrinkage data on the various mixes were obtained on 1 by 1 by 5 in.

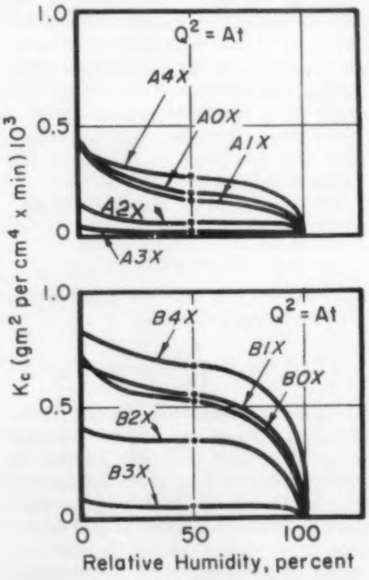

Fig. 4.—Capillary coefficients of mixes A and B, with and without admixtures.

NOTE.—Code designations are the same as for Figs. 1 and 3.

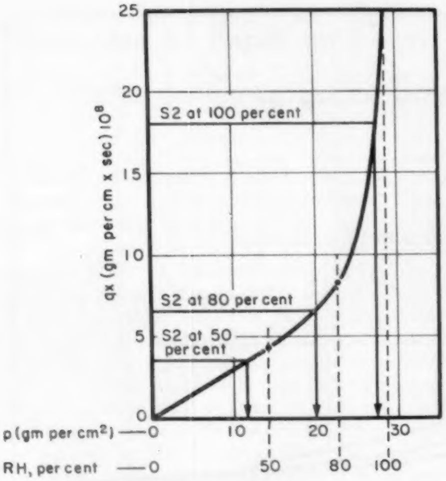

Fig. 5.—Use of flow data for uncoated specimen in determining P_1 values for rating surface coatings S2.

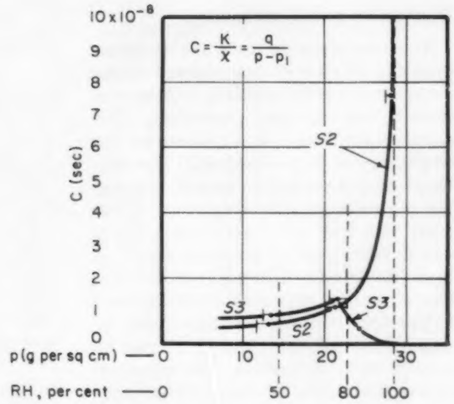

Fig. 6.—Vapor conductances of surface coatings S2 and S3.

mortar bars cured for 11 days at 100 per cent relative humidity and 73.4 F, and then conditioned at 50 per cent relative humidity and 73.4 up to 60 days. The slight but possible adverse influence of integral waterproofing materials on drying shrinkage is illustrated by the following results: A0X (no admixture)—0.071 per cent, A1X—0.087 per cent, A2X—0.086 per cent, A3X—0.077 per cent, and A4X—0.094 per cent.

The data in the preceding sections are for the rich mix only. Data for the mix B showed similar trends.

Specimens with Surface Waterproofing Materials

The Unsaturated Permeability Test.—The dry-cup test was carried out in the same manner as described previously. The rates of moisture flow were determined for 50, 80, and 100 per cent relative humidity conditions at the painted side of the specimens. Test results obtained from the uncoated series S0 were used to plot the qx curve of the uncoated concrete (Fig. 5). With the aid of this curve and with the experimental results of the coated series, it was possible to obtain the moisture conductances of the surface waterproofing films, which will subsequently be referred to as paint films.

It was considered that a partial pressure drop $p - p_1$ would be attained in the paint film, resulting in a smaller pressure drop $p_1 - p_0$ in the concrete than it would have experienced in the uncoated state. Therefore the rate of flow q_1 obtained for the painted specimen would be smaller than the rate of q of the unpainted specimen. q_1 was determined experimentally. To find p_1, use was made of Fig. 5. A horizontal line was drawn from the point q_1x to its intersection of the qx curve. Then a vertical line was drawn leading down to the p_1 value. The pressure p_1 was determined by this procedure for each of the cases and the moisture conductance of the paint film was calculated from the equation:

$$C = \frac{q_1}{p - p_1}$$

and plotted against $p_m = (p + p_1)/2$, giving three points, one for each of the three tests at 50, 80, and 100 per cent relative humidities. The three points were connected by a curve and the moisture conductance of the paint film was obtained for the whole range of vapor pressures. Only the results for points S2 and S3 are shown in Fig. 6 since S1 (cement paste) had no apparent effect in moisture flow. The curves show that:

(*a*) paint S2 gave decreased flow rates; the curve of conductance had the same general shape as the curve of the unsaturated permeability coefficient of concrete; and

(*b*) paint S3 gave decreased flow rates, especially at higher humidities; the curve of vapor conductance follows the curve of paint S2 up to 80 per cent relative humidity, but at higher humidities, instead of rising to higher values, it drops to a very low value at 100 per cent relative humidity. This shows the remarkable effect of the silicone waterproofer at higher humidities.

The special test of unsaturated permeability with water and air on the two sides of the specimens was carried out by the inverted wet-cup method as described previously. The paint film was applied (*a*) to the wet side, and (*b*) to the dry side. Results of tests (*a*) again showed excellent agreement with the results of dry-cup tests; results of tests (*b*) showed no benefit except for the silicone waterproofer S3. This would indicate that the cement-base waterproofing materials were beneficial when they were painted on the upstream side but apparently not beneficial when they were painted on the evaporation side.

The Saturated Permeability Test.—The test was carried out in the same manner as for the specimens containing integral waterproofing materials. The results showed that paints S1 and S2 did not affect the rates of permeability at all. Paint S3, on the contrary, showed no leakage under the small head of water during the seven days of the test. As a matter of interest, a higher water pressure of 30 psi was applied resulting in definite leakage. After the specimens had leaked for one night and had become saturated, the pressure was decreased to its original small value. After that the leakage stopped again. It can be concluded that paint S3 was very effective against small water pressures.

The Capillary Absorption Test.—The capillary absorption at 50 per cent relative humidity equilibrium conditions was determined from the initial inflow measurements in the saturated permeability apparatus. The fact that paint and concrete represented two different layers made it impossible to establish a simple theory and to determine a coefficient of absorption as described previously. Figure 7 shows the rates of absorption obtained for the series S0, S1, S2, and S3. As seen from this figure, S1 and S2 decreased capillarity and increased the time of complete water penetration through the 1-in. specimens. For S3 water had not penetrated the sample to any extent even after 7 days.

Discussion and Conclusions

The test methods used in this investigation, taken together, showed promise as a means of evaluating integral and surface waterproofing materials. The results show clearly that reliance on one single test is not adequate. The materials tested showed to no advantage in the saturated permeability test. However, this test may have some merit where filler-type or pozzolanic admixtures are used. The unsaturated permeability test appeared to make clear distinction between certain types of waterproofings and could be related to certain field situations. In practical testing it may not be necessary to apply both the dry-cup and the wet-cup methods unless field conditions warrant it. The capillary absorption test gave a good indication of the over-all effectiveness of waterproofings in cases where concrete is subjected to short periods of contact with moisture, with intermediate drying intervals.

The water repellent and bituminous admixtures showed up favorably in all the tests except the saturated permeability test. The calcium chloride admixture showed no beneficial effects in this study, apparently because the cement used did not respond to the usual accelerating action of calcium-chloride on hydration.

The cement-base paints provided varying degrees of benefit when painted on the side of the specimen subjected to wetting. The silicone application had a very significant influence on moisture flow.

The differences obtained with waterproofing agents used in these studies indicate that the combination of tests described provides a simple and useful means of evaluating such materials on the basis of the different field problems which may be anticipated.

The tests, however, were limited to isothermal conditions and to relatively early ages of concrete. The influence of age and temperature gradient, as well as durability and corrosion resistance properties, require additional investigation before final conclusions can be drawn.

Acknowledgment:

The authors acknowledge the constructive criticism afforded during the course of this study by N. B. Hutcheon, P. J. Sereda, and J. M. Kuzmak, all of the Division of Building Research, National Research Council, Ottawa, Canada.

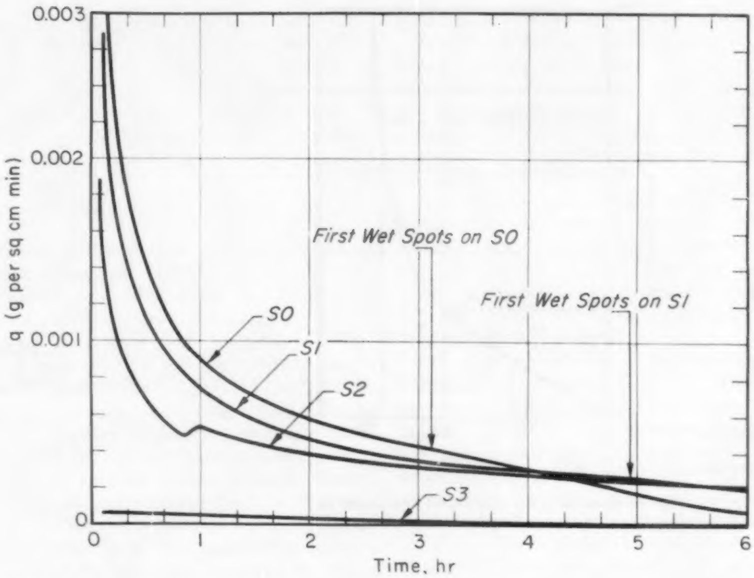

Fig. 7.—Capillary flow with surface coatings S1, S2, and S3; compared with uncoated specimen S0

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Discussion of Paper on Effect of Length to Diameter Ratio on Compressive Strength of Concrete[1]

Mr. N. G. Zoldners.[2]—It is gratifying that action is being taken to further study of concrete strength correction factors given by ASTM Standard Method C 42[3] in a tabulation for test cylinders whose l/d ratio is less than 2.

Our experience indicates that concrete, having a compressive strength of 3000 psi and over is unjustly penalized by the present set of correction factors if the l/d ratio is 1.0 or less.

The reciprocals of the ASTM factors, as plotted in the accompanying Fig. 13, show straight line progression from an l/d ratio of 2.0 to 1.25, after which the curve bends sharply, which has the effect of markedly increasing the correction for short cylinders beyond the proper value. Such a break in the curve is illogical and cannot occur with uniform material as a result of a gradual change of cylinder height.

We feel that investigations conducted by us, in connection with test results on cylinders with varying l/d ratios, might be of help in compiling more information about the factual values of the strength correction factors.

In 1956 numerous tests were conducted by the writer at the concrete laboratory of Mount Royal Paving and Supplies Ltd., to compare the compressive strength of 6 in. diam cylinders of varying length with the strength of standard size (6 by 12 in.) test cylinders. To eliminate as far as possible the effect of coarse aggregate size on the internal friction angle in the shear planes, only concrete with ½-in. maximum size crushed limestone and natural sand was used. Samples large enough to mold a full set of test cylinders were secured on the job site from regular ready-mixed concrete at 3 to 4-in. slump and brought in pails to the laboratory. A set of three standard and eight short-length cylinders were cast in cardboard cylinder molds, cut off by 1-in. decrements from 12 to 3-in. in height, and cured under standard laboratory conditions until tested—one standard cylinder for 7 days and the rest for 28 days. For compression tests, the cylinders were all capped with leadite caps in a Nardiello capping machine. Test sets were grouped according to the ultimate strength results of 28-day standard test cylinders in four strength ranges, and results compiled in Table VIII.

The average relative strength values for each cylinder size when plotted on the graph, outline a curve, which represents the reciprocals of the correction factors for concrete within a certain strength range.

Figure 13 shows clearly that different sets of correction factors have to be used for different strength ranges of concrete, which is in agreement with the authors' conclusion.

The several values of the correction factors which are established here are for a particular set of testing conditions and materials as described.

A well-organized research program to collect more information concerning the effect of l/d ratio on the apparent compressive strength of concrete, with variables such as strength, slump, curing, age, aggregate, and whether molded or cored, has been started under the auspices of ASTM Subcommittee III a, of Committee C-9 on Concrete and is well under way. One of the 12 participating organizations taking part in this cooperative research program is Mount Royal Paving and Supplies Ltd.

Messrs. M. A. Sozen and T. J. Larsen.[4]—The general use of a compression test as an index of the properties of concrete has created the necessity for translating the results of nonstandard tests into the language of the standard test since concrete does not show the same compressive strength under different conditions. The geometry of the test specimen is one of these conditions. Messrs. Murdock and Kesler deserve praise for their comprehensive survey of American research on the effect of the length-diameter ratio and their insight into the problem.

The structural engineer, on the other hand, is interested essentially in the properties of concrete in the structural unit. The wide differences in strength measured from compression test specimens and from structural members under combinations of axial load, shear, and flexure are well known. One case commanding interest from two points of view is the axially loaded column which may be regarded both as a structural member and as a compression test specimen.

Tests of plain concrete columns at Lehigh University[5] and at the Uni-

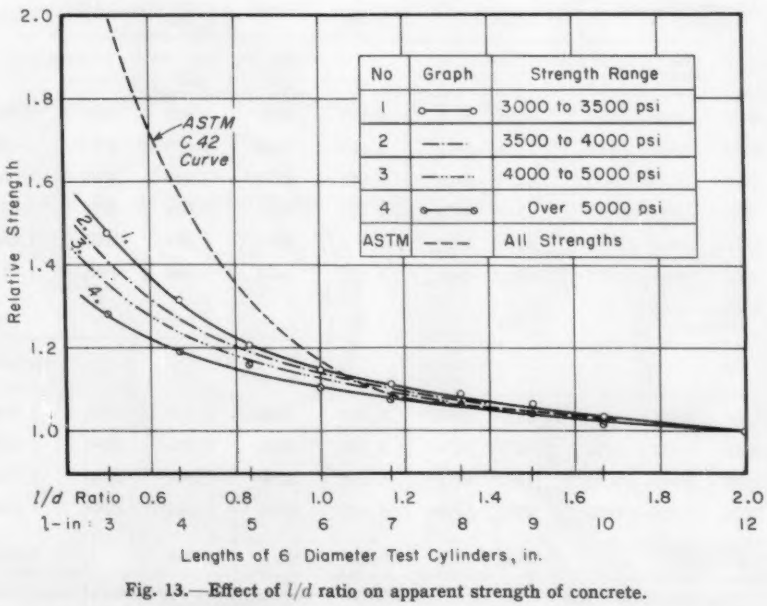

Fig. 13.—Effect of l/d ratio on apparent strength of concrete.

[1] J. W. Murdock and C. E. Kesler, "Effect of Length to Diameter Ratio of Specimen on the Apparent Compressive Strength of Concrete," ASTM Bulletin, No. 221, April, 1957, p. 68 (TP76).

[2] Senior concrete engineer, Mount Royal Paving and Supplies Ltd., Montreal, P. Q., presently Senior Scientific Officer, Industrial Minerals Division, Department of Mines and Technical Surveys, Ottawa, Canada.

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[4] Assistant professor and graduate student, respectively, Department of Civil Engineering, University of Illinois, Urbana, Ill.

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TABLE VIII.—EFFECT OF L/D RATIO ON THE APPARENT COMPRESSIVE STRENGTH OF CONCRETE.

6-in. Diam Cylinders

Test Number	Concrete Mix	Standard Test Cylinder, 7 days	Standard Test Cylinder, 28 days	Standard Test Cylinder, 28 days Average	10 in. Long, Compressive Strength, psi	10 in. Long, l/d Ratio, 1.67 Relative Strength	9 in. Long, Compressive Strength, psi	9 in. Long, l/d Ratio, 1.50 Relative Strength	8 in. Long, Compressive Strength, psi	8 in. Long, l/d Ratio 1.33 Relative Strength	7 in. Long, Compressive Strength, psi	7 in. Long, l/d Ratio, 1.17 Relative Strength	6 in. Long, Compressive Strength, psi	6 in. Long, l/d Ratio, 1.00 Relative Strength	5 in. Compressive Strength, psi
							RANGE: 3000 TO 3500 PSI								
5111...	3000—½	2583	3398 3345	3371	3592	1.065	3644	1.081	3733	1.107	3804	1.129	3839	1.139	4246
5150...	3000—½	2522	3407 3239	3323	3502	1.054	3433	1.033	3627	1.091	3662	1.102	3698	1.113	3946
5154...	3000—½	2531	3291 3230	3260	3221[a]	0.988	3274	1.005	3398	1.043	3556	1.091	3751	1.151	3892
5179...	3000—¼	2336	3203 3150	3176	3283	1.034	3495	1.101	3502	1.103	3680	1.159	3680	1.159	3892
5254...	3000—½	2619	3547 3468	3507	3627	1.035	3857	1.100	3928	1.120	4016	1.146	4264	1.216	4388
5263...	3000—¼	2442	3203 3097	3150	3221	1.022	3345	1.061	3520[a]	1.118	3468	1.101	3804	1.208	3821
Exp-9..	3000—½	2406	3256 3291	3273	3309	1.011	3451	1.055	3502	1.070	3592	1.098	3644	1.114	3857
5290...	3000—¼	2663	3529 3556	3542	3550	1.002	3627	1.023	3804	1.074	3839	1.084	3910	1.103	4335
5303...	3000—¼	2052	3141 3212	3176	3362	1.059	3442	1.084	3574[a]	1.126	3486	1.098	3538	1.114	3751
5346...	3000—½	2699	3309 3398	3353	3502	1.044	3662	1.092	3769	1.124	3786	1.129	3839	1.145	3910
Average Relative Strength.....				1.000	...	1.036	...	1.064	...	1.092	...	1.114	...	1.146	...
							RANGE 3500 TO 4000 PSI								
5100...	3000—½	2894	3769 3928	3848	3928	1.021	4052	1.054	4211	1.095	4459	1.159	4583	1.191	4881
5156...	3000—½	2885	3804 3839	3821	4016	1.051	3946	1.033	4087	1.069	4140	1.083	4370	1.044	4618
5240...	3000—½	3150	4007 3928	3967	4140	1.044	4352	1.098	4317	1.089	4370	1.102	4477	1.129	4848
5269...	3000—¼	3008	3928 3998	3963	3963[a]	1.000	3981	1.005	4087	1.031	4246	1.071	4618	1.165	4863
Exp-8..	3000—½	3000	3821 3981	3901	3875[a]	0.996	4069	1.043	4087	1.048	4140	1.061	4335	1.111	4547
5323...	3000—½	2637	3574 3644	3609	3662	1.015	3725	1.031	3963	1.098	3928	1.088	4034	1.118	4229
5363...	3000—½	2964	3892 3769	3830	3910	1.021	3963	1.035	3963	1.035	4069	1.063	4246	1.108	4512
5113...	3000—½	2548	3609 3538	3573	3627	1.015	3751	1.050	3769	1.055	3715[a]	1.040	3998	1.119	4264
5164...	3000—¼	2823	3407 3751	3597	3644	1.014	3724	1.036	3751	1.044	3963	1.101	3928	1.092	4140
Average Relative Strength.....				1.000	...	1.026	...	1.043	...	1.063	...	1.091	...	1.120	...
							RANGE: 4000 TO 5000 PSI								
5092...	4000—½	3653	4715 4742	4728	4706	0.996	4988	1.055	5041	1.065	5182	1.097	5235	1.107	5783
5122...	4000—½	3609	4882 4645	4763	5042	1.059	5148	1.080	4971[a]	1.043	5184	1.088	5113[a]	1.077	5449
5128...	3000—½	3442	4211 4335	4273	4406	1.031	4317	1.010	4529	1.060	4459	1.043	4813	1.127	5007
5138...	4000—½	3653	4715 4918	4816	4971	1.032	5024	1.044	5236	1.087	5024[a]	1.044	5325	1.106	5538
5171...	4000—½	3981	4786 4689	4737	5024	1.061	5024	1.061	5059	1.068	5343	1.129	5431	1.146	5644
5261...	4000—½	3574	4848 4777	4812	4848	1.007	4813	1.000	4866	1.011	5024	1.044	5024[a]	1.044	5325
Average Relative Strength.....				1.000	...	1.031	...	1.042	...	1.058	...	1.080	...	1.122	...
							RANGE: OVER 5000 PSI								
5157...	4000—½	4600	5555 5679	5617	5502	0.981	5644	1.006	5661	1.009	5573	0.993	5838	1.040	5994
5244...	5000—½	4953	5573 5767	5670	5874	1.036	6051	1.068	6281	1.108	6387	1.126	6440	1.136	6900
5236...	4000—½	4016	5095 5219	5107	5413	1.060	5520	1.081	5555	1.088	5679	1.112	5732	1.122	6127
5308...	4000—¾	4193	5484 5555	5519	5396	0.977	5626	1.019	5767	1.045	5892	1.067	6121	1.109	6440
Average Relative Strength.....				1.000	...	1.014	...	1.043	...	1.062	...	1.074	...	1.102	...

[a] Apparently erroneous test results were eliminated in figuring the average results of relative strength values.

Long	4 in. Long		3 in. Long	
l/d Ratio, 0.83 Relative Strength	Compressive Strength, psi	l/d Ratio, 0.67 Relative Strength	Compressive Strength, psi	l/d Ratio, 0.50 Relative Strength
1.259	4565	1.354	5076	1.505
1.188	4246	1.277	4654	1.400
1.194	4300	1.320	4795	1.471
1.225	4229	1.332	4848	1.527
1.251	4706	1.342	5378	1.534
1.213	4388	1.393	4884	1.550
1.148	4069	1.243	4370	1.336
1.223	4512	1.274	5201	1.468
1.181	3892	1.226	4388	1.381
1.166	4618	1.377	5290	1.578
1.205	...	1.314	...	1.475
1.269	4899	1.274	5472	1.421
1.208	5042	1.320	5449	1.426
1.221	5343	1.349	5980	1.508
1.227	5219	1.317	6051	1.526
1.165	4671	1.198	5272	1.351
1.171	4636	1.284	5059	1.401
1.179	4848	1.266	5130	1.339
1.194	4565	1.278	4884	1.367
1.151	4494	1.250	4848	1.348
1.198	...	1.282	...	1.410
1.235	5925	1.254	6526	1.381
1.144	5909	1.241	6617	1.388
1.172	5272	1.234	5626	1.318
1.150	5750	1.194	6493	1.349
1.191	6281	1.326	6723	1.420
1.106	5767	1.199	6493	1.349
1.166	...	1.241	...	1.368
1.059	6263	1.116	6847	1.220
1.216	7218	1.272	7554	1.332
1.200	5981	1.171	6387	1.250
1.166	6688	1.211	7289	1.320
1.160	...	1.192	...	1.281

versity of Illinois[6] carried out in connection with the American Concrete Inst. column investigation generally indicated that the strength of the concrete in the column was about 85 per cent of the 6 by 12-in. cylinder strength. Since the vertically cast columns were 60 in. long and had an l/d ratio of about 7.5, this difference may be attributed to the effect of the l/d ratio as observed in compression test specimens and to the fact that the water-cement ratio may vary considerably over the height of a vertically cast column. On a suggestion by C. P. Siess of the University of Illinois the following exploratory tests investigating the effect of casting position on column strength were carried out at Talbot Laboratory. By casting horizontally 'columns' with l/d ratios ranging from $\frac{1}{2}$ to 8, the relative effects of l/d ratios were also studied.

Each of the six test series comprised nine prisms having lengths of 3, 6, 9, 12, 18, 24, 30, 36, and 48 in. The cross-sectional dimensions for all prisms were 6 by 6 in. Five 6 by 12-in. cylinders were cast for each series. The longest specimens having l/d ratios of 8 corresponded roughly to the cylindrical plain concrete columns of the previous Lehigh and Illinois investigations. The shorter prisms were in the realm of compression-test specimens.

Two series were cast for each of the following nominal concrete strengths: 2500, 4700, and 6500 psi.

Fabrication of Specimens

Marquette type I portland cement purchased locally in one lot was used for all specimens. Wabash river sand and gravel were used as aggregates. The maximum size of the coarse aggregate was 1 in. The fineness modulus for the sand was 3.30. The mixes used were 1:4.3:6, 1:3.8:5.2, and 1:2.8:3.9 by weight for the three different levels of strength. The corresponding water–cement ratios were 1.00, 0.77, and 0.59, by weight, respectively. The mixing time was 4 min for each batch of about 5.5 cu ft which was mixed subsequent to a butter mix of about 2 cu ft. A nontilting drum mixer of 6-cu ft capacity was used. In order to have as uniform a mix as possible, each batch was mixed with a spade in the wheelbarrow after being taken out of the mixer.

The forms for the prisms were prepared by placing machined steel plates at the required locations in existing steel forms for beams of 6 by 6 in. in cross-section. Steel forms were used for the cylinders. Five cylinders and nine prisms having the required lengths were cast from one batch. Each specimen, including the cylinders, was carefully vibrated with a high-frequency internal vibrator. The cylinders were capped with neat cement about four hours after casting. The prisms were not capped since they had reasonably smooth and plane ends because of the machined end plates. All specimens were taken to the moist room one day after casting and stored there for six days. After 21 more days of storage in the laboratory air, they were tested.

Testing Procedure

The cylinders were tested in a 300,000-lb Olsen hydraulic testing machine. The stressing rate was 50 psi per sec.

The prisms were tested in a 600,000-

[6] F. E. Richart and R. L. Brown, "An Investigation of Reinforced Concrete Columns," University of Illinois Experimental Station Bulletin 267 (1934).

TABLE IX.—MEASURED COMPRESSIVE STRENGTH PSI, OF PRISMS AND CYLINDERS.

		La	Lb	Ma	Mb	Ha	Hb
l/d Ratios:	½	5550	5780	9110	..[a]	11610	..[a]
	1	2890	3200	5480	5660	8130	6530
	1½	3070	3140	5260	5600	7090	7090
	2	3000	3010	5050	5430	6530	7150
	3	2940	3030	5110	5070	6770	6610
	4	[a]	2840	4790	4600	6790	6780
	5	2930	2970	4890	4920	6320	6920
	6	2620	2700	4710	5120	6130	6640
	8	2810	2910	4910	4920	6420	6530
Cylinders:	A	2490	2770	4900	4840	6290	6850
	B	2440	2660	4540	4870	6150	7060
	C	2190	2580	4590	4350	6290	6750
	D	2300	2540	4810	4770	6250	6890
	E	[a]	[a]	4580	4740	6570	6580
Average		2360	2640	4680	4720	6320	6830

[a] Specimen damaged prior to test.

lb Riehle screw-type testing machine. To maintain as uniform a straining rate as possible, the head speed was 0.05 in. per min for the 3, 6, 9, and 12-in. long prisms, and 0.10 in. per min for the 18, 24, 30, 36, and 48-in. prisms. Before the tests, the cross-sectional dimensions of the prisms were determined at the top, at mid-height, and at the bottom. The specimens were plumbed and centered in the testing machine, and a preload of about 2000 to 4000 lb was applied through a spherical bearing block at the top, which was then prevented from further rotation by the use of wedges. This procedure provides a "flat-end" test which assures concentric loading and corresponds to that used in the Illinois column tests.

Test Results

Concentric and eccentric failure cones were observed in all specimens. The location of the cone varied at random over the length of the column in the long specimens. The brittleness of the specimens appeared to increase with concrete strength.

The results of the tests are recorded in Table IX. The symbols *L*, *M*, and *H* indicate the series with low, medium, and high concrete strengths. The symbols *a* and *b* refer to the different series of specimens for each strength of concrete. The compressive strength is tabulated against the l/d ratio for each specimen. The compressive strengths of the 6 by 12-in. cylinders are also listed for each batch with the average cylinder strength given in the bottom line. Tables X and XI list the reduced data expressed as ratios of the average 6 by 12-in. cylinder strengths and of the compressive strength of prisms with l/d ratios of 2, respectively. The data of Table XI are plotted in Fig. 14.

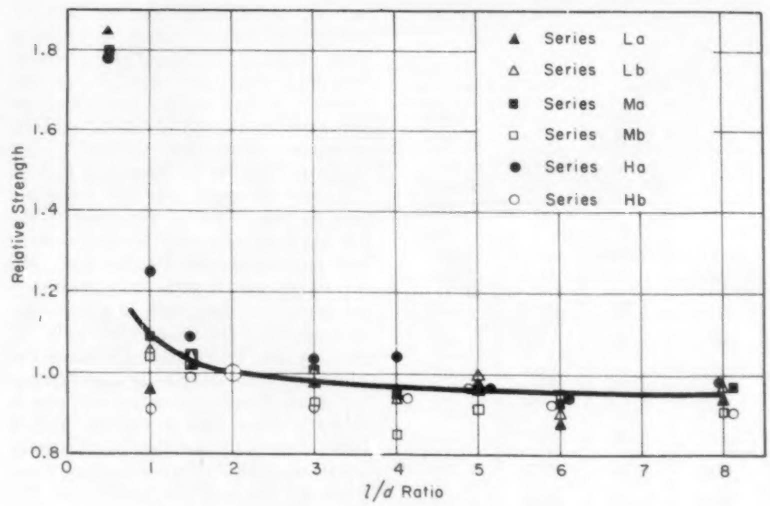

Fig. 14.—Effect of l/d ratio on prism strength.

The data obtained from these exploratory tests are too limited to provide a basis for general conclusions. However, certain trends merit mention. The data in Table X indicate that the prism strengths were greater than the average cylinder strength, except for series *Hb* for which the prisms yielded strengths slightly less than the average cylinder strength. Therefore, it is likely that the apparent strength of concrete in horizontally cast short columns would be equal to or greater than the 6 by 12-in. cylinder strength. Presumably, there can be a greater or at least a more critical variation in the water-cement ratio through the depth of a cylinder than through the height or width of a horizontally cast column. Also, the factor 0.85 relating column to cylinder strength observed in the plain concrete column tests, may have been largely caused by the manner of casting. The general trend of the data in Fig. 14 and Table XI indicates that there was a reduction in strength with increase in l/d ratio. However, this reduction is less than that usually observed in tests of vertically cast specimens.

TABLE X.—COMPARISON OF PRISM AND CYLINDER STRENGTHS.

	Measured Strength of Prism / Average Cylinder Strength					
	La	*Lb*	*Ma*	*Mb*	*Ha*	*Hb*
l/d Ratio: ½.....	2.35	2.19	1.95	[a]	1.84	[a]
1.....	1.24	1.21	1.17	1.20	1.29	0.96
1½....	1.30	1.19	1.24	1.19	1.22	1.04
2.....	1.27	1.14	1.08	1.15	1.03	1.06
3.....	1.25	1.15	1.09	1.09	1.07	0.97
4.....	[a]	1.08	1.02	0.98	1.07	0.99
5.....	1.24	1.13	1.05	1.04	1.00	1.01
6.....	1.11	1.02	1.01	1.09	0.97	0.97
8.....	1.19	1.10	1.05	1.04	1.02	0.96

[a] Specimen damaged prior to test.

TABLE XI.—EFFECT OF l/d RATIO ON PRISM STRENGTH.

	Measured Strength of Prism / Measured Strength of Prism with l/d = 2					
	La	*Lb*	*Ma*	*Mb*	*Ha*	*Hb*
l/d Ratio: ½.....	1.85	1.92	1.80	[a]	1.78	[a]
1.....	0.96	1.06	1.09	1.04	1.25	0.91
1½....	1.02	1.04	1.04	1.03	1.09	0.99
2.....	1.00	1.00	1.00	1.00	1.00	1.00
3.....	0.98	1.01	1.01	0.93	1.03	0.92
4.....	[a]	0.94	0.95	0.85	1.04	0.95
5.....	0.98	0.99	0.97	0.91	0.97	0.97
6.....	0.87	0.90	0.93	0.94	0.94	0.93
8.....	0.94	0.97	0.97	0.91	0.98	0.91

[a] Specimen damaged prior to test.

MESSRS. John W. MURDOCK AND Clyde E. KESLER (*authors' closure*).—The authors wish to thank Messrs. Zoldners, Sozen, and Larsen for the discussions and data furnished. Mr. Zoldners' data supports the conclusions of the authors.

Messrs. Sozen and Larsen have provided data which extends the range of l/d ratios included in the original paper. Increasing the l/d ratio to 8 causes a continuing decrease in the apparent strength of the concrete, although the decrease is rather small for l/d ratios larger than 2. These specimens were tested with fixed ends and slightly different results might have been expected if the ends of the specimen had been free to rotate.

Intergranular Corrosion Resistance of Austenitic Stainless Steels

*A Ferric Sulfate-Sulfuric Acid Test**

By MICHAEL A. STREICHER

The test is specific for intergranular attack associated with carbide precipitation in unstabilized steels, takes only 120 hr, utilizes simple flask and condenser apparatus and permits testing of several specimens in the same flask

THE EXCELLENT corrosion resistance of the austenitic stainless steels to a large variety of corrosive environments has led to widespread use of these steels. However, as was recognized by the earliest users, this superior corrosion resistance is sometimes largely offset in certain media by a susceptibility to severe intergranular attack. The grain boundaries may be made susceptible by inadvertent exposure of the steels to temperatures in the range of 1000 to 1600 F during manufacture or fabrication. Depending on the composition of the steel, either or both of two types of precipitates may be formed in the grain-boundary zones. The most important of these consists of chromium carbides in steels containing more than about 0.025 per cent carbon. In 18 Cr-8 Ni (Mo) steels, a second type of susceptibility, associated with the formation of sigma phase at the grain boundaries, may also be produced. Both types of intergranular susceptibility can be eliminated in most cases by high-temperature heat treatment and rapid cooling.

For users of stainless steel it is essential to know that all material to be exposed to certain media is immune to intergranular attack. As a result, there has been a continuing need for accelerated tests to evaluate such stainless steels for their resistance to this type of corrosion. In the case of the austenitic stainless steels, the available knowledge of the causes of susceptibility to intergranular attack provides a valid basis for the use of accelerated testing methods. The results of these tests do not provide data for estimates of service life but are, rather, a means of determining the degree of susceptibility to intergranular attack.

In the following section the characteristics of evaluation methods now in use are discussed. Various limitations inherent in each of these indicate a need for a new evaluation test. The development and performance of a ferric sulfate-sulfuric acid test which fulfills the requirements of such a new test are then described.

Commonly Used Evaluation Tests

Of the various acid solutions proposed for accelerated tests, the most frequently used are 65 per cent nitric acid, copper sulfate-sulfuric acid, and nitric-hydrofluoric acid. The oxalic acid etching test may be used to screen specimens from these tests on the basis of their etch structures. All four tests have been used in the present investigation for comparison with the ferric sulfate-sulfuric acid test.

The sensitivity or resolving power of quantitative evaluation tests depends on the difference between the rate of general and of intergranular corrosion. In order to obtain a measure of this sensitivity, two specimens, one resistant to intergranular attack (annealed) and the other susceptible (heated 1 hr at 1250 F), were tested from each heat of steel. The ratio obtained by dividing the corrosion rate of the susceptible by that of the resistant specimen was used to compare the results obtained in the evaluation tests.

Nitric Acid Test[1]

In the boiling 65 per cent nitric acid test, developed by Huey (**1**),[2] the weight loss of a specimen of known surface area is determined after each of five 48-hr exposure periods. The corrosion rate, usually given in inches penetration per month, is determined by averaging the rates calculated from the weight losses for each of the five periods. For a resistant steel, the corrosion rate is low and constant throughout the entire 240-hr exposure period. On a susceptible specimen, the attack at the grain

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* A paper describing the "Nitric-Hydrofluoric Acid Evaluation Test for Type 316L Stainless Steel" by Donald Warren, Engineering Research Laboratory, E. I. du Pont de Nemours, Inc., will appear in the May issue of the ASTM BULLETIN.

[1] "Tentative Recommended Practice for Boiling Nitric Acid Test for Corrosion-Resisting Steels" (A 262 - 55 T) 1955 Book of ASTM Standards, Part 1, p. 1108.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

boundaries leads to undermining and dislodgment of metal grains and progressively increasing period rates. The nitric acid test is the only known test in which intergranular attack is the result of both chromium carbide and sigma-type intergranular precipitates (**2**,**3**).

For the tests reported in this paper, 600 ml of 65 per cent nitric acid was used for each specimen in a 1-liter Erlenmeyer flask fitted with a water-cooled condenser. The specimens were ground to an 80-grit finish and held in glass cradles. Because the chromium corrosion products are known to accelerate attack on stainless steel in nitric acid (**4**, **5**), fresh acid was used for each 48-hr period.

Copper Sulfate-Sulfuric Acid Test

This combination of reagents, originally developed by Hatfield (**6**), has been used in various proportions. In the present investigation, 600 ml of boiling solution containing 5.7 per cent $CuSO_4$ and 15.7 per cent H_2SO_4 (by weight) was used for each specimen.[3] Exposure to this solution produces intergranular attack only on those steels containing intergranularly precipitated chromium carbides (**2**,**3**,**7**). The attacked zone on grain boundaries is such that the large majority of grains remain in place. Also, general corrosion on grain faces is very low. As a result, the change in weight, even on steels suceptible to intergranular corrosion, is very small and cannot be used as a means of measuring the extent of intergranular attack.

The most commonly used method for routine evaluation of the results of this test consists of bending a 1-in. wide by 2- or 3-in. long specimen through an angle of 180 deg and examining the surface for cracks, which indicate intergranular attack. Another method involves dropping the specimen on a hard surface. If the specimen retains its original ring, it is considered free of intergranular attack. A dull sound, such as a piece of lead gives, indicates severe intergranular corrosion. Metallographic examination of cross-sectional areas for measurement of the depth of intergranular penetration has also been used. The qualitative evaluations have actually been found to be more sensitive indications of intergranular corrosion than the only quantitative method available for this test, measurement of changes in electrical resistance (**7**). For such measurements, first used by Rutherford and Aborn (**8**), a modified Kelvin bridge, thin specimens from 3 to 5 in. long, and exposure periods of hundreds of hours are required. This resistance method, which is more suitable for research than for routine evaluation, was used in this investigation.

A commonly used exposure period for routine evaluation by the bend test is 72 hr. This exposure period has been decreased to 15 or 20 hr by Rocha and Brauns and Pier (**9**), who greatly increased the rate of intergranular attack in the copper sulfate-sulfuric acid solution by placing the stainless steel specimens in contact with copper chips.

Nitric-Hydrofluoric Acid Test

This solution has been used primarily to reveal susceptibility to intergranular corrosion in the heat-affected zones of welded austenitic stainless steels (**3**, **10**). The acid concentrations, temperature, and testing times have not been standardized. A solution of 10 per cent nitric acid and 3 per cent hydrofluoric acid (by weight) was selected for this investigation. "Saran" pots, covers, and cradles were used for the $1\frac{1}{2}$-hr tests at 65 C.

As in the case of the copper sulfate-sulfuric acid solution, the nitric-hydrofluoric acid test reveals only that type of susceptibility to intergranular attack which is associated with the precipitation of chromium carbides (**2**, **11**). Even though the exposure periods required for the nitric-hydrofluoric acid test are only 2 to 4 hr, this method is not being used extensively for routine evaluation because of the influence of alloy composition on the large amount of general attack (**2**, **11**). Also, the special equipment and the care required for the handling of hydrofluoric acid and for holding the temperature of the solution below boiling make the routine use of this test less attractive.

Oxalic Acid Etch Test[4]

Intergranularly precipitated chromium carbides can also be detected by microscopic examination of etch structures. The oxalic acid etch for stainless steels (**12**) has been developed into a rapid (15 min) standardized screening test (**13**), which may be used to eliminate samples from testing in other evaluation tests on the basis of their etch structures. For the standard test, the steel is anodically etched 1.5 min in a 10 per cent solution of oxalic acid at a current density of 1 amp per sq cm.

The etch structures are divided into three types, depending on the amount and extent of intergranular chromium carbide precipitate. In the absence of intergranular carbide, the different rates of dissolution of individual grains result in steps at the grain boundaries, "step structure." When there is carbide precipitate which does not completely surround any grains, the specimen is classed as "dual structure," and when it surrounds one or more grains completely, as "ditch structure." With the exception noted below, specimens having step or dual structures do not require testing in the three evaluation tests described. Such specimens would not drop grains during these tests and would, therefore, have low corrosion rates in the nitric acid and the nitric-hydrofluoric acid tests. Any steel having a "ditch structure" may drop grains in these tests with a consequent increase in corrosion rate. Whether this corrosion rate is within the arbitrarily set acceptable rate for the evaluation tests can be determined only by performing these tests.

The exception to this use of oxalic acid etch structures involves type 316 steel, which may be subject to both sigma and carbide type of intergranular corrosion in the nitric acid test. Exposure of this steel to temperatures in the range of 1000 to 1600 F will result in some precipitation of chromium carbides because of its carbon content. Since some sigma phase, which may not be detectable in the etch structure, can also form during this thermal exposure, any type 316 steel having carbides in the structure must be submitted for testing in nitric acid. Therefore, when type 316 steels are screened for the nitric acid test, only those having a step structure can be eliminated from testing (**14**).

Type 316L steel may be entirely free of chromium carbide precipitates and yet be subject to severe intergranular attack in nitric acid because of sigma type susceptibility. For this reason, the oxalic acid etching test *cannot* be used to screen these steels from the nitric acid test. However, the oxalic acid etch test is applicable to these steels when they are being screened from the nitric-hydrofluoric acid and copper sulfate-sulfuric acid tests, which reveal only the type of intergranular susceptibility associated with chromium carbide precipitate.

Ferric Sulfate-Sulfuric Acid Test

Of the two types of intergranular susceptibility, the one associated with the precipitation of chromium carbides may be found in all the austenitic stainless steels and is known to lead to intergranular attack in a large number of corrosive media, for example, sulfuric, phosphoric,

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[3] This is the same concentration given in ASTM Tentative Recommended Practice for Conducting the Acidified Copper Sulfate Test for Intergranular Attack in Austenitic Stainless Steels (A 393 – 55 T) 1955, Book of ASTM Standards, Part 1, p. 1135. It may be prepared by adding 100 g $CuSO_4 \cdot 5H_2O$ and 100 ml H_2SO_4 (sp gr 1.84) to 840 ml of water.

[4] A description of this test is included in Recommended Practice for Boiling Nitric Acid Test for Corrosion Resisting Steels (A 262 – 55 T), 1955 Book of ASTM Standards, Part 1, p. 1108.

and organic acids. In contrast, the sigma type of susceptibility appears only in certain grades and, in the case of AISI 316 and 316L steels, is known to cause intergranular attack only in nitric acid exposures (**15**). There is, therefore, a need for a quantitative evaluation test for routine use that will reveal only the carbide type of intergranular susceptibility. Such a test would be suitable for the evaluation of all austenitic stainless steel specimens except those few 316 and 316L steels which represent material to be used in nitric acid plant service. These few specimens must be evaluated in nitric acid. Even though the nitric-hydrofluoric acid test is such a quantitative test, it has not found general acceptance because of its inherent disadvantages, which have been described above.

That a ferric sulfate-sulfuric acid test might meet the requirements was suggested by some data obtained in an investigation of intergranular corrosion in a number of acids inhibited with ferric salts (**16**). It was found that in several acids containing ferric salts there is intergranular attack which leads to undermining and dislodgment of individual grains and, therefore, a readily detectable weight loss.[5] This graindropping was observed only on those steels which contained intergranularly precipitated chromium carbides and not on those containing the sigma type of intergranular susceptibility. Of the acids investigated, ferric-ion-inhibited sulfuric acid gave the most rapid intergranular attack. The action of ferric sulfate in inhibiting general corrosion of stainless steel in sulfuric acid was first described by Hatfield (**17**).

[5] This is in contrast to the action of cupric sulfate-sulfuric acid solutions, which also produce intergranular attack on such steels, but without appreciable dislodgment of grains.

TABLE I.—ANALYSES OF STAINLESS STEELS.

Steel		Weight, per cent					
Code	Type	Chromium	Nickel	Molybdenum	Carbon	Manganese	Silicon
M304	304	18.3	9.3	...	0.063	0.80	0.37
FK-2	304L	19.2	10.7	...	0.031	0.94	0.35
FK-3	304L	18.9	11.1	...	0.028	1.29	0.55
FK-4	304L	18.3	11.0	...	0.020	1.06	0.37
M316	316	17.7	12.6	2.45	0.046	1.68	0.61
FI4	316L	16.2	13.2	2.2	0.020	1.6	0.47
FI6	316L	18.8	12.8	2.4	0.022	1.85	0.44
GS-1	316	17.6	13.27	2.24	0.033	2.09	0.45

Effect of Concentration of Sulfuric Acid

To determine the acid concentration which, with ferric sulfate, will give the most rapid rate of intergranular attack without an excessive increase in general corrosion, a series of tests were made in solutions of various acid concentrations. All were made in boiling solutions containing 15 g per 600 ml (25 g per liter) reagent grade, hydrated ferric sulfate: 75 per cent $Fe_2(SO_4)_3$. The apparatus used, 1-liter Erlenmeyer flasks, fitted with water-cooled condensers, and glass cradles for holding corrosion specimens, was the same as that recommended[1] for nitric acid tests. The solutions were changed at about 24-hr intervals. Specimens (approximately 18 sq cm in area) of type 304 and 316 steels (analyses M304 and M316 in Table I) were selected for these tests. One set of tests was made on annealed steels (all carbides in solid solution) and the other set on specimens heat treated 1 hr at 1250 F. This heat treatment precipitated a large quantity of chromium carbides which completely surrounded most grains in both steels. All specimens were ground to an 80-grit finish, except for a 1-sq cm area on some specimens, which was electropolished for metallographic observation.

The results for type 304 steel have been plotted in Figs. 1 and 2. On the sensitized specimens, in all concentrations of acid, intergranular attack led to grain-dropping. This was very slight in 30 per cent acid and increased rapidly with increasing acid concentration. As a result, the corrosion rate (slope of curves in Fig. 1) increased with length of exposure time. On the annealed specimens, there was no grain-dropping; the corrosion rate was much lower and constant with length of time of immersion in all concentrations of acid.

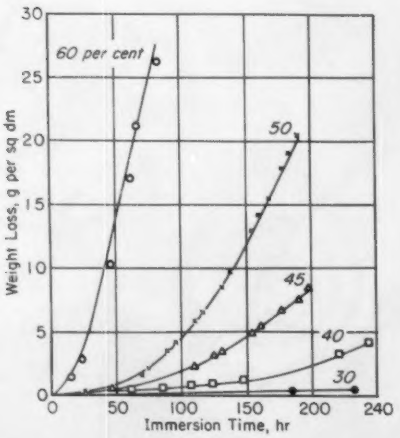


Fig. 1.—The effect of concentration of sulfuric acid on corrosion of sensitized AISI-304 steel in boiling ferric sulfate-sulfuric acid solution.

Solution: 600 ml with 15 g ferric sulfate (acid concentrations in weight per cent). *Specimens:* AISI-304 (M304, Table I) heated 1 hr at 1250 F.

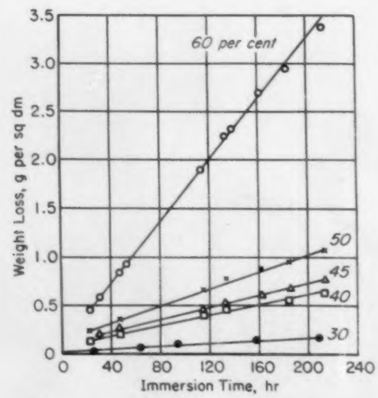
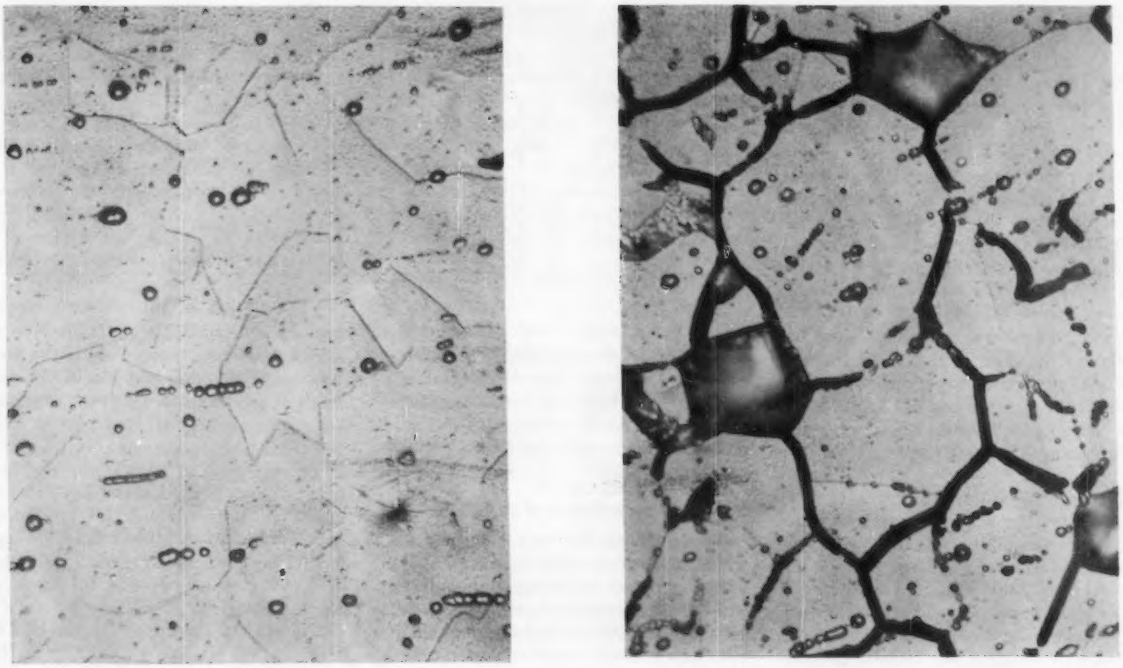


Fig. 2.—The effect of concentration of sulfuric acid on corrosion of annealed AISI-304 steel in boiling ferric sulfate-sulfuric acid solution.

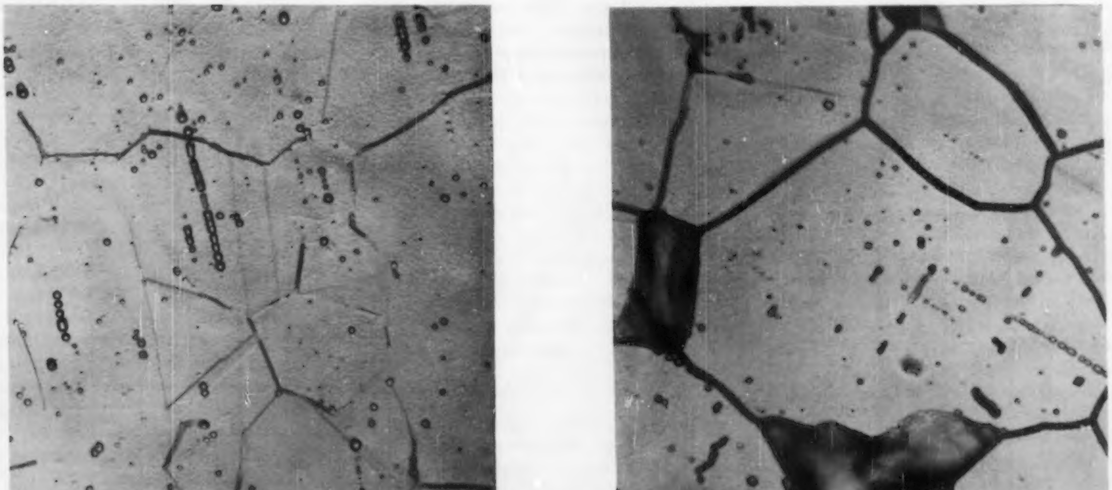
Solution: 600 ml with 15 g ferric sulfate (acid concentrations in weight per cent). *Specimens:* AISI-304 (M304, Table I) annealed.



A—Annealed M304, after 40-hr exposure.

B—Sensitized (1 hr at 1250 F) M304 after 34-hr exposure.

Fig. 3.—Corrosion of type 304 steel in boiling ferric sulfate-sulfuric acid solution (×500)
Solution: 50 per cent acid containing 15 g per 600 ml ferric sulfate.



A—Annealed M316 after 40-hr exposure.

B—Sensitized (1 hr at 1250 F) after 27-hr exposure.

Fig. 4.—Corrosion of type 316 steel in boiling ferric sulfate-sulfuric acid solution (×500)
Solution: 50 per cent acid containing 15 g per 600 ml ferric sulfate.

The microstructures in Figs. 3 and 4 illustrate these results on type 304 and 316 steels. On the annealed specimens, exposure to the ferric sulfate-sulfuric acid solution brought out steps between grains. The 316 steel also developed a few grain-boundary sections which were ditched. These ditches were relatively shallow and did not lead to undermining and dropping of grains. (This phenomenon is more pronounced on the 316L steels described below). After only 30 hr, several small grains had already dropped out of the surface of the *sensitized* specimens. The grain faces remained almost entirely free of attack during this period.

As the concentration of acid was increased, both the rate of intergranular and of general corrosion increased. To obtain a measure of the sensitivity of the acid solutions in discriminating between sound material and intergranularly susceptible steel, the weight loss of the sensitized specimen was divided by the weight loss of the corresponding annealed specimen. The larger this ratio is for a given set of specimens, the greater is the sensitivity or resolving power of the testing conditions. A list of the ratios is given in Table II. For both the 304 and 316 steels, the ratio increased with increasing acid concentration and length of testing time. Thus, as the acid concentration is increased, the increase in intergranular attack is greater than the increase in general corrosion.

For comparison, the data obtained on type 304 steel in the 50 per cent sulfuric acid solution have been plotted in Fig. 5, together with those obtained on this same steel in the boiling 65 per cent nitric acid test. After 240 hr of exposure in nitric acid, the weight loss of the sensitized steel is about 5.5 g per sq dm. In the 50 per cent sulfuric acid–ferric sulfate solution, this same weight loss is reached in 110 hr of exposure. The ratio for the 240-hr nitric acid weight losses is 11.6. A similar sensitivity, that is ratio, is obtained in the 50 per cent sulfuric acid solution after only 120 hr (Table II). Thus, the sensitivity of a 5-day, 50 per cent sulfuric acid test appears to be equal to that of the standard 10-day nitric acid test. The 50 per cent sulfuric acid solution was selected for all subsequent tests.

If a test of greater sensitivity is required, the length of the testing period can be increased from 120 to 180 hr or the acid concentration from 50 to 60 per cent. Also, there is a possibility of a 72-hr test in 60 per cent acid having a sensitivity equal to or greater than the 120-hr, 50 per cent acid test.

TABLE II.—THE INFLUENCE OF ACID CONCENTRATION AND OF LENGTH OF TESTING TIME ON THE SENSITIVITY OF FERRIC SULFATE-SULFURIC ACID SOLUTIONS TO DETECT SUSCEPTIBILITY TO INTERGRANULAR CORROSION.

Solution: Boiling sulfuric acid containing 15 g per 600 ml ferric sulfate.
Steels: AISI-304 and 316 (M304, M316 Table I).

Concentration of Acid, per cent by Weight	Ratio of Weight Losses[a] — Length of Time of Immersion: 72 hr	120 hr	180 hr	200 hr
	AISI-304			
30	...	1.3	2.7	2.7
40	2.2	2.0	3.3	4.0
45	3.1	5.7	11.5	13.0
50	4.5	10.0	18.5	20.0
60	17.2	18.4	...	...
	AISI-316			
30	1.0	1.6	1.4	1.4
40	2.2	3.0	4.0	4.8
45	4.0	7.0	10.0	12.2
50	6.9	13.5	21.7	...
60	10.5	...	...	...

[a] $\dfrac{\text{Weight loss, in g per sq dm, of specimen heated 1 hr at 1250 F.}}{\text{Weight loss, in g per sq dm, of annealed specimen.}}$

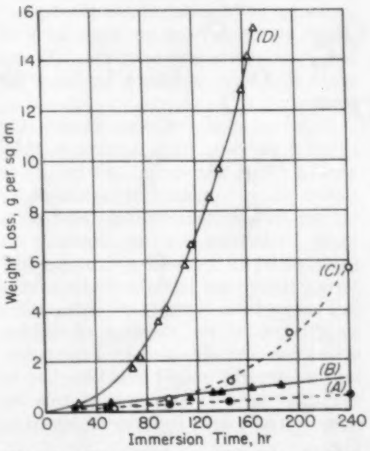


Fig. 5.—Corrosion of AISI-304 steel in ferric sulfate-sulfuric acid solution and in nitric acid test.

Steel: M304, composition in Table I. *Solutions:* Boiling 50 per cent sulfuric acid with 15 g per 600 ml ferric sulfate. Boiling 65 per cent nitric acid.
Annealed Steel: A—in nitric acid. B—in ferric sulfate-sulfuric acid.
Sensitized Steel (1 hr at 1250 F): C—in nitric acid. D—in ferric sulfate-sulfuric acid.

Effect of Concentration of Ferric Sulfate

To establish the optimum concentration of ferric sulfate to be used with the 50 per cent sulfuric acid solution, data were needed on the minimum amount of ferric salt required to suppress general corrosion and on the consumption of ferric ions during corrosion of stainless steel. The minimum concentration of ferric sulfate was determined by exposing annealed type 304 steel specimens to a series of solutions, each of which contained a different concentration of ferric sulfate. The data have been plotted in Fig. 6. At a concentration between 0.6 and 0.8 g per 600 ml, there was a sudden decrease of corrosion from about 77 to about 0.015 g per sq dm hr. Smaller amounts of ferric sulfate than 0.6 g do not affect the uninhibited corrosion rate appreciably, nor do amounts in excess of 0.8 g affect the inhibited rate. This response is characteristic of ferric-ion inhibition of stainless steels in acids (16). The 0.8 g of ferric sulfate yields 0.17 g of ferric ion.

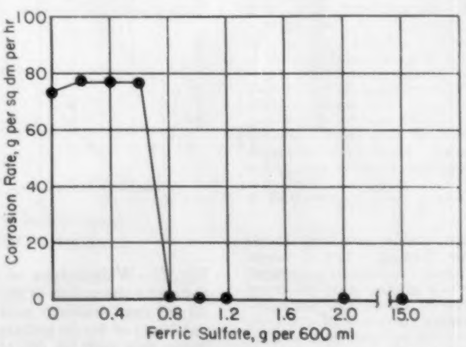


Fig. 6.—Effect of ferric sulfate on corrosion of annealed type 304 steel in boiling 50 per cent sulfuric acid.

Ferric Sulfate: 75 per cent $Fe_2(SO_4)_3$

The solubility of ferric sulfate ($Fe_2(SO_4)_3 . nH_2O$, 75 per cent minimum ($Fe_2(SO_4)_3$), was found to be 48 g per 600 ml (80 g per liter) in boiling 50 per cent sulfuric acid. When a solution with ferric sulfate in excess of solubility contains a rapidly corroding specimen, the solids disappear after a few days and the solution becomes clear, an indication that ferric ions are consumed in the corrosion process.

The dissolution of iron, chromium, and nickel at anodic areas on the corroding stainless steel (reaction I below) is electrochemically related to reducing reactions at cathodic areas on the surface (reactions II and III). In acid solutions without ferric ions, this involves the discharge of hydrogen ions to hydrogen gas. However, in the presence of ferric ions, reaction II may be almost completely replaced by the conversion (reaction III) of ferric to ferrous ions (**16**,**18**), which then results in consumption of inhibitor.

$$\left.\begin{matrix}Fe\\Cr\\Ni\end{matrix}\right\} \xrightarrow{-e} Fe^{+2} + Cr^{+2} + Ni^{+2} \quad \text{(I)}$$

$$2H^+ + 2e \rightarrow 2H \rightarrow H_2 \quad \text{(II)}$$

$$Fe^{+3} + e \rightarrow Fe^{+2} \quad \text{(III)}$$

The above-mentioned observation on the disappearance of excess ferric sulfate during exposure of a rapidly corroding specimen and the fact that no hydrogen gas evolution has been observed, even on intergranularly susceptible steels, suggest that ferric-ion consumption (reaction III) is the most important of the two cathodic reactions.[6]

[6] In the nitric acid test the evolution of fine gas bubbles on corroding steels is readily apparent even though the corrosion rates are only about one half those in the inhibited 50 per cent sulfuric acid solution.

[7] Conversion of ferrous to ferric ions was detected by periodically exposing a stainless steel specimen to a boiling 50 per cent solution of sulfuric acid containing 15 g per 600 ml of ferrous sulfate (colorless). This solution gradually turned yellow. When the specimen was immersed after 31 hr of boiling it remained passive; that is, about 0.17 g per 600 ml of ferric ions had been formed.

[8] The theoretical amount of stainless steel dissolved in a solution inhibited with 10 g ferric sulfate was calculated on the assumption that Cr, Ni, and Fe dissolve to the divalent state. Of the 10 g ferric sulfate added, 9 g is available for consumption before activation sets in. These contain 20.8 per cent or 0.0334 moles of Fe^{+3}. The stainless steel used was 18.9 Cr, 9.27 Ni, and by difference, 71.8 Fe. One gram of this steel contains 0.018 moles of metal. Each mole of metal dissolving to divalent ions requires two moles of ferric ions. Thus $\frac{0.0334}{2 \times 0.018} = 0.93$ g stainless steel.

[9] When stainless steels dissolve, Fe^{+2}, Ni^{+2}, and Cr^{+2} are formed. The divalent chromium (light blue) is rapidly changed to the trivalent (dark green) state in these solutions. Hexavalent chromium (orange-red), which accelerates corrosion of stainless steel, does not form in sulfuric acid during the dissolution process. This is in contrast to the behavior in nitric acid in which trivalent chromium is oxidized to the hexavalent state, which accelerates corrosion.

Tests were made to obtain a quantitative measure of ferric-ion consumption. At the moment when the concentration of ferric ions is reduced to slightly less than the minimum amount required for inhibition, there is a tremendous increase in corrosion rate accompanied by profuse evolution of hydrogen; that is, there is then uninhibited corrosion of the hydrogen-evolution type. If, in inhibited solutions, reaction III is the main cathodic reaction, there is a direct relationship between the amount of metal dissolved at the moment of activation and the quantity of ferric sulfate added initially to the solution. For these tests, accurate weight loss–time data, which could be extrapolated one or two hours, were required. Also, the total testing time had to be restricted to about 7 hr because a gradual conversion of ferrous to ferric ions in boiling sulfuric acid solutions was observed.[7] These requirements were met by using large areas of annealed steel, whose corrosion rates are constant with time, in more concentrated (60 per cent) acid than was used for the other tests.

Stainless steel foil was wound into cylindrical coils, each having a total area of about 600 sq cm. From one to three coils were placed in each of three boiling 60 per cent sulfuric acid solutions containing various amounts of ferric sulfate. Periodic weight loss determinations were made to obtain weight loss *versus* time of exposure data. The weight loss at the moment of sudden activation was obtained by extrapolating the straight weight loss–time line to the total time of exposure at this instant. The results have been plotted in Fig. 7.

The line at 1 g of ferric sulfate is the minimum amount required for inhibition in 60 per cent acid and was determined in tests similar to those described above. From Fig. 7, it is apparent that about 9 g of ferric sulfate is consumed by the dissolution of 1 g of the steel used in this test. The theoretical amount, calculated on the basis of reactions I and III, is 0.93 g[8], which is within the accuracy of the measurements used for the tests. These results, together with the fact that no hydrogen gas bubbles were observed in any of the solutions, some of which contained as much as 1500 sq cm of corroding surface, show that the reduction of ferric ions is the main cathodic reaction. Acid consumption is, therefore, negligible. The primary function of the acid in the dissolution process appears to be its dissolving action on the continually forming protective film.

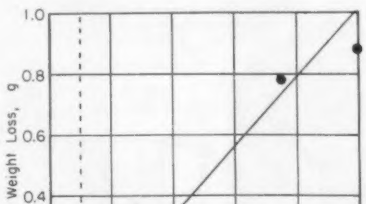


Fig. 7.—Weight-loss of stainless steel at time of exhaustion of ferric salt in boiling 60 per cent sulfuric acid as a function of amount of ferric sulfate added initially.
Tests were made on foil of annealed type 304 steel varying in area from 500 to 1500 sq cm in 600 ml of solution. 1 per 600 ml of solution is the minimum amount of ferric sulfate required for inhibition in 60 per cent solution.

Reproducibility

Factors of importance in routine use of any evaluation test are (*a*) the reproducibility of the rates on specimens of the same heat of steel, (*b*) the effect of corrosion products on the corrosion process, and (*c*) the influence of alloy composition on the general corrosion rate. To obtain data on reproducibility, a number of specimens of the same heat of steel were run, each in a separate flask, for periods of 48–48–24 hr. A new solution was used for each period. The results are given in Table III. There was good agreement among the rates of duplicate tests. On the sensitized specimens, from which there was profuse grain-dropping, the average deviation from the mean value was 7 per cent, and the maximum deviation was 12 per cent.

The action of corrosion products was investigated by running three specimens in one flask. Two of these were known to corrode rapidly, and the third was a specimen, FK-2, which was known to be only slightly susceptible to intergranular attack; that is, there was a small amount of grain-dropping. The results, listed in Table III, showed that the corrosion products did not affect the corrosion rate. The rates of the two sensitized type 304 specimens were essentially the same as those of specimens of this heat run in individual flasks. Also, the rate of the FK-2 steel was the same as when it was tested singly.

An additional test was made by adding synthetic corrosion products in the form of divalent iron and nickel and trivalent chromium sulfates to the ferric sulfate-sulfuric acid solution.[9] The amounts added were equivalent to those found in a solution in which about 4 g of stainless steel had dissolved. Again, there was no effect on the corrosion rate (Table III).

TABLE III.—REPRODUCIBILITY OF FERRIC SULFATE-SULFURIC ACID TEST

Steels: AISI-304 and 304L (M304, FK-2, Table I).
Solution: 600 ml boiling, 50 per cent sulfuric acid with 15 g per 600 ml of ferric sulfate.

Specimen	Heat Treatment	Type of Test	Corrosion Rate 120-hr Test in. per month
M304	Annealed	One per flask	0.00179
M304	Annealed	One per flask	0.00202
M304	1 hr at 1250 F	One per flask	0.0212
M304	1 hr at 1250 F		0.0191
M304	1 hr at 1250 F		0.0216
M304	1 hr at 1250 F		0.0187
M304	1 hr at 1250 F		0.0233
			0.0208 Average[a]
M304	1 hr at 1250 F	All in one flask	0.0237
M304	1 hr at 1250 F	New solution after 48 and 96 hr	0.0235
FK-2	1 hr at 1250 F		0.00221
FK-2	1 hr at 1250 F	One per flask	0.00284
M304	1 hr at 1250 F	One per flask plus synthetic corrosion products[b]	0.0236

[a] Maximum deviation = 12 per cent, average deviation = 7 per cent. In the 240-hr nitric acid test the rates of three specimens (heated 1 hr at 1250 F) of this same steel were 0.00853 0.00842, and 0.00624 in. per month.

[b] 14 g $FeSO_4 \cdot 7H_2O$, 1.9 g $NiSO_4 \cdot 6H_2O$ and 4.6 g $Cr_2(SO_4)_3 \cdot xH_2O$ (minimum 65 per cent) in 600 ml of solution.

The effect of alloy composition on the general corrosion rate was not investigated systematically. A comparison of the corrosion rates of annealed steels (Table IV) shows that the highest rate is about twice as great as the lowest rate in both the ferric sulfate-sulfuric acid and in the nitric acid test.

Testing Conditions

As described above, there is practically no consumption of acid and no effect of corrosion products on the rate of attack. This suggested that several specimens could be run simultaneously in one flask without changing the acid during the entire 120-hr testing period, as long as there was enough ferric sulfate in the solution to provide inhibition. Two runs were made to provide data on this possibility. In one flask containing 600 ml of 50 per cent sulfuric acid and 50 g of ferric sulfate, three sensitized specimens of heat M304 (Table I) and one annealed specimen were exposed simultaneously for 120 hr without changing the solution. In another flask a similar test was made using M316 specimens. On the type 304 steel, the results were 0.00146 in. per month for the annealed and 0.0196, 0.0313, 0.0267 in. per month for the sensitized specimens. The rates for the type 316 (M316) steel were 0.00129 for the annealed and 0.0104, 0.0106, 0.0106 in. per mo. for the sensitized specimens. These rates are in good agreement with those obtained in tests using one specimen per flask and frequent changes of acid (Tables III and IV).

On the basis of these results, the following testing conditions have been selected:

Solution.—600 ml of boiling 50 per cent sulfuric acid with an amount of ferric sulfate depending on the number of specimens used per flask. About 10 g of ferric sulfate is required for each gram of steel dissolved. The total amount of ferric sulfate should not exceed the solubility, 48 g per 600 ml of solution at boiling temperature.

The solution may be prepared by adding 400 ml water to a 1-liter, Erlenmeyer flask and 236 ml reagent grade 96 per cent sulfuric acid. Concentrated acid contains from 95 to 98 per cent H_2SO_4. If, instead of the 96 per cent acid used for calculation of the volumes of water and acid given above, the acid actually was 95 or 98 per cent, the resulting concentrations of the solutions would be 49.4 and 50.9 per cent. These variations in acid concentration do not result in significant changes in corrosion rates.

Exposure Period.—120 hr without change of solution. Since the acid vapor above the boiling acid does not contain ferric sulfate inhibitor, the specimens should not be held in this space any longer than necessary during their immersion or removal. Specimens must be free of all oxide scale formed during heat treatments. Such scale may be the cause of activation by galvanic action with the metal. Also, care should be taken to avoid loss of vapor during boiling because the resulting increase in concentration of sulfuric acid in the remaining liquid will lead to an increase in corrosion rate. Breaking the test into two periods may be desirable in order to provide a means of detecting possible error in initial weighing.

TABLE IV.—COMPARISON OF THE FERRIC SULFATE-SULFURIC ACID TEST WITH OTHER EVALUATION TESTS.

Type	Code	Heat Treatment, deg Fahr	Oxalic Acid Etch Structure	HNO_3-HF[a]		240-hr -HNO_3 In. per month	(Flask) Ratio[b]	Sulfuric Acid Tests, 50 Per Cent Acid + Ferric Sulfate, in. per month			
				Inches per month	Ratio[b]			120 hr	Ratio[b]	240 hr	Ratio[b]
304	M304	Annealed	Step			0.00067	...	0.00179	...	0.00177	...
		1 hr 1250	Ditch			0.00853	12.8	0.021	11.8	0.042	23.8
304L	FK-2	Annealed	Step			0.00050	...	0.00135	...	0.00115	...
		1 hr 1250	Ditch			0.00104	2.1	0.00284	2.1	0.00422	3.7
304L	FK-3	Annealed	Step			0.00050	...	0.00138	...	0.00132	
		1 hr 1250	Dual			0.00066	1.3	0.00138	1.0	0.00144	1.1
304L	FK-4	Annealed	Step			0.00053	...	0.00160	...	0.00147	...
		1 hr 1250	Dual			0.00063	1.2	0.00160	1.0	0.00158	1.1
316	M316	Annealed	Step	0.16	...	0.00077	...	0.00164	...	0.00181	...
		1 hr 1250	Ditch	0.87	5.6	0.015	19.0	0.013	7.8	0.033	18.5
316L	FI-4	Annealed	Step	0.50	...	0.00111	...	0.00173	...	0.00181	...
		1 hr 1250	Step	0.51	1.0	0.039	35.6	0.00236	1.4	0.00316	1.75
316L	FI-6	Annealed	Step			0.00049	...	0.00096	...	0.00083	...
		1 hr 1300	Sigma (fine)			0.065	133.0	0.00093	1.0	0.00125	1.5
		4 hr 1600 + 1 hr 1300	Agglomerated Sigma			0.00068	1.4	0.00101	1.0	0.00093	1.1
			BAR STOCK								
316	GS-1	As Received	Step and end-face pitting			0.00598		0.00206			
316	EH-4	As Received	Step and end-face pitting			0.067		0.00258		0.00363	
316	HQ-4	As Received	Step and end-face pitting			0.046		0.00203		0.00301	

[a] 10 per cent HNO_3-3 per cent HF at 65 C in 1.5-hr test.

[b] Ratio of corrosion rate of sensitized specimen divided by rate of annealed specimen.

Application of the Ferric Sulfate-Sulfuric Acid Test to Various Stainless Steels

A selected group of stainless steels was exposed in the ferric sulfate-sulfuric acid test. For comparison, these same steels were also given the standard oxalic acid etch, the standard nitric acid test, and, in some cases, the nitric-hydrofluoric acid and the copper sulfate-sulfuric acid tests. In each case an annealed specimen was tested along with one which was heat treated at a temperature most likely to result in susceptibility to intergranular attack. On all specimens tested in the ferric sulfate-sulfuric acid solution, an area of 1 sq cm was electropolished to facilitate metallographic observation of the progress of corrosion. The results are given in Table IV and the analyses for all steels in Table I.

Types 304 and 304L Steels

These steels are subject only to the chromium carbide type of intergranular attack. The behavior of steel M304 has already been illustrated in Fig. 2. The ratio of the 120-hr sulfuric acid test is about the same as that in the 240-hr nitric acid test and is doubled by a total exposure of 240 hr.

The sensitized FK-2 steel, which had a ditch structure in the oxalic acid etch test, dropped some grains in the nitric acid test. It has been found that a rate of 0.0010 in. per month or greater in the nitric acid test indicates grain-dropping on unstabilized steels.[10] The ratio was 2.1, which is identical to that found in the 120-hr sulfuric acid test. After 240 hr, the ratio increased to 3.7, which is further proof of intergranular attack. On this steel, a rate of 0.0010 in. per month in the nitric acid test is equivalent to 0.0028 in. per month in the 120-hr sulfuric acid test. Thus, about 0.0025 in. per month appears to be the rate in the 120-hr sulfuric acid test which divides the intergranularly resistant steels from those that drop grains.

The FK-3 and FK-4 steels both have "dual" etch structures in the heat-treated condition: that is, some intergranular carbides, but not sufficient to result in grain-dropping. The nitric acid and sulfuric acid test results are in agreement with the etch structures. The ratios are all about 1 and do not increase with testing time in the sulfuric acid test.

Types 316 and 316L Steels

These steels may contain either carbide or sigma type of intergranular susceptibility, or both. For example, on M316 steel, the ratio for the nitric acid test is 19 as compared with 7.8 in the 120-hr sulfuric acid test and 5.6 in the nitric-hydrofluoric acid test. The higher ratio in nitric acid indicates that both types of susceptibility are present in this heat, because when only carbide susceptibility is present, the ratios in the nitric acid and the 120-hr sulfuric acid tests are about the same (note results on 304 and 304L steels above).

The relatively slow progress of intergranular attack in the copper sulfate-sulfuric acid test, as detected by measurements of electrical resistance, is shown by the relatively small increase in resistance of 40 per cent found on a sensitized M316 specimen exposed for 1000 hr.[11] The resistance may increase as much as 800 per cent before a specimen $\frac{1}{16}$ in. thick breaks.

The two 316L heats were selected to reveal the performance of the various tests on steels which were free of carbide precipitate after heat treatment but contained various forms of the sigma type of intergranular susceptibility. Thus, on the FI-4 steel (0.020 per cent carbon, 16.2 per cent chromium) after 1 hr at 1250 F, there is no trace of any intergranular chromium carbide precipitate in the etch structure. Nor is there any visible evidence of sigma phase (Fig. 8). Nevertheless, this specimen has a very high corrosion rate in the nitric acid test and a ratio of 35.6. This high rate is a result of intergranular attack caused by "invisible" sigma, probably a preprecipitation phase. As expected, in the nitric-hydrofluoric acid test, the ratio is 1, reflecting the absence of the carbide type of susceptibility.

In the ferric sulfate-sulfuric acid solution, the ratio is also approximately 1. The reason for the slight increase over 1 is apparent in Fig. 9. Even on the annealed specimen, there is extensive grain-boundary etching. This intergranular etching is somewhat more pronounced on the sensitized specimen, but does not lead to undermining and dropping of grains, even after 240 hr of exposure. Grain-boundary etching of intergranularly resistant steels also takes place in nitric acid, for example, on annealed steels, and should, therefore, not be used as a criterion of susceptibility to intergranular attack. The most reliable criterion is dropping of grains ("sugaring") after prolonged exposure.

The other 316L steel (FI-6) developed a fine, discrete precipitate of sigma phase at the grain boundaries during heat treatment of 1 hr at 1300 F. However, this visible precipitate seems insufficient to account for the very high nitric acid rate and ratio. There must also have developed some invisible sigma phase of the type found in FI-4 above. Again, the ratio in the ferric sulfate-sulfuric acid solution is 1 after 120 hr of exposure and 1.5 after 240 hr. This steel also showed grain-boundary etching, but less than FI-4.

A stabilizing heat treatment of 4 hr at 1650 F before heating 1 hr at 1300 F agglomerates the sigma constituent and eliminates the intergranular susceptibility found only in the nitric acid test.

Bar Stock, End-Face Attack[12]

On cross-sectional areas of bar stock there is sometimes accelerated attack, while the sides of these same specimens remain relatively unaffected. This susceptibility to end-face attack is indicated by numerous deep pits in the oxalic acid etch structure.[4] In order to compare the effect of end-face susceptibility in the nitric and sulfuric acid tests, three heats of type 316 bar stock, known to be susceptible to end-face attack, were tested. The same piece of metal was used first for the sulfuric acid and then, after thorough grinding, for the nitric acid test. From the data given in Table IV, it is seen that all three of these heats have very high corrosion rates in the nitric acid test. These are a result of severe end-face attack, which is accompanied by grain-dropping. Intergranular attack on annealed metal in nitric acid is caused by hexavalent chromium, which accumulates especially near the rapidly corroding end-face surfaces.

In the ferric sulfate-sulfuric acid test, the corrosion rates on these same specimens are almost the same as on annealed steel, that is, about 0.0020 in. per month after 120 hr of exposure. Further exposure results in some increase in this rate, a result of some growth of the end-face pits and intergranular etching of the kind described above. However, there is no intensification of corrosion by corrosion products. Thus, the end-face susceptibility in these steels, which results in very high nitric acid rates, does not lead to accelerated corrosion in the sulfuric acid test.

Summary

The ferric sulfate-50 per cent sulfuric acid test gives results in one-half the time required for the standard nitric acid test. Since corrosion products do not accelerate attack in the ferric sulfate-sulfuric acid solution, as many as four specimens may be tested in one

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[10] A commonly used nitric acid test acceptance rate for 304L steels after heating of 1 hr at 1250 F is 0.0020 in. per month. This heat treatment is used on steels which are to be welded during fabrication to provide data on the amount of intergranular susceptibility which might be produced by welding.

[11] The copper sulfate-sulfuric acid tests were made without metallic copper in the solution.

[12] Accelerated attack on surfaces perpendicular to direction of deformation.

flask and the same solution may be used for the entire 120-hr exposure. Also, there is no intensification of end-face face attack on bar stock by corrosion products. The oxalic acid etching test may be used to separate those AISI 304, 304L, 316 and 316L steels which do not drop grains, and, therefore, have low corrosion rates, from those that may drop them in the ferric sulfate-sulfuric acid test.

Only the chromium carbide type of intergranular susceptibility, which may occur in all grades of austenitic stainless steels, is revealed by the ferric sulfate-sulfuric acid test. The sigma type of intergranular susceptibility in AISI 316 and 316L steels leads to intergranular attack only in nitric acid. Therefore, the ferric sulfate-sulfuric acid test appears applicable to specimens of all unstabilized austenitic grades except those representing 316 and 316L steels intended for service in nitric acid.

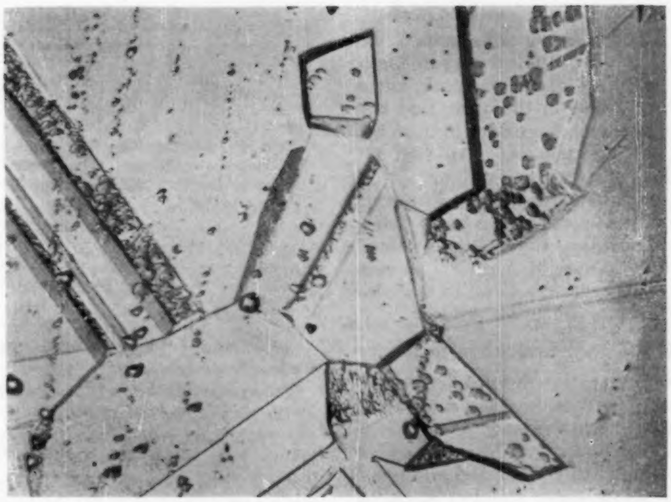
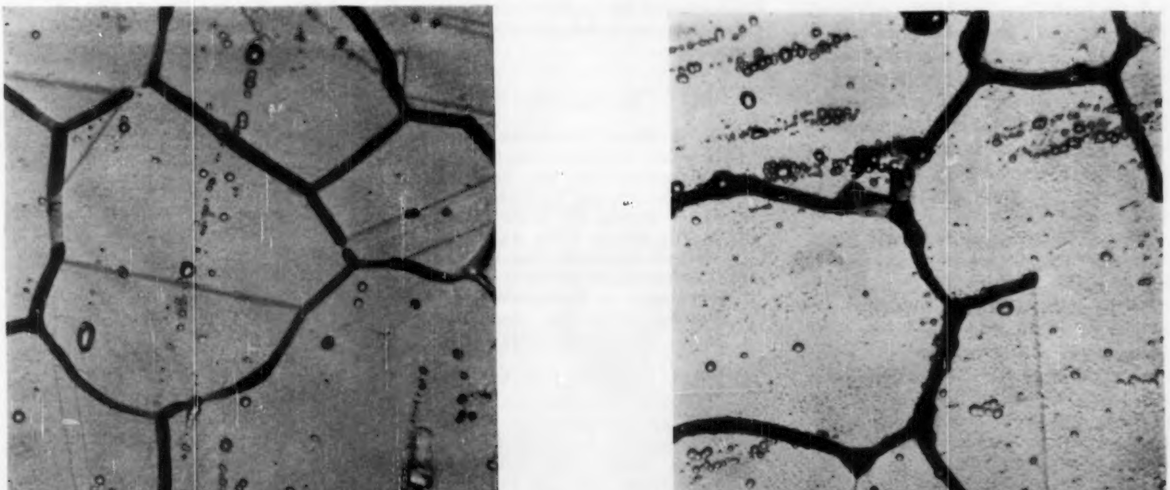


Fig. 8.—Oxalic acid etch of 316L (FI-4) steel heated 1 hr at 1250 F (×500)

Typical step structure despite 1 hr heating at 1250 F.
Nitric acid corrosion rate, 0.0394 in. per month.

These results are based on a selected group of steels which were used to illustrate the various phenomena known to be associated with intergranular attack in stainless steels. No extensive correlation between the ferric sulfate-sulfuric acid and other evaluation tests has been made. Before the sulfuric acid test can be used on a routine basis, further tests are required to determine maximum permissible corrosion rates for various grades of stainless steels.

In other tests (not described herein) on AISI 321 steels it was found that the chromium carbide type of susceptibility to intergranular attack, which occurs in these steels when stabilization of carbon by titanium is incomplete, may be readily detected by the nitric acid, nitric-hydrofluoric acid, ferric sulfate-sulfuric acid and oxalic acid etching tests. The presence of a second type of suscepti-



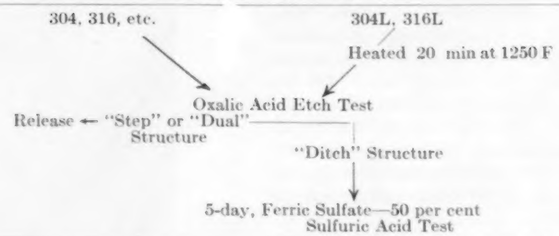
A—Annealed steel after 62 hr exposure.

B—Sensitized (1 hr at 1250 F), after 62 hr exposure.

Fig. 9.—Corrosion of type 316L (FI-4) in boiling ferric sulfate-sulfuric acid solution (×500)

bility to accelerated corrosion, associated with a phase similar to sigma phase, is not detected in the nitric-hydrofluoric acid test or the oxalic acid etch, but is readily revealed in the nitric acid test and to a much lesser extent in the ferric sulfate-sulfuric acid test. An AISI 321 steel having a corrosion rate ratio of 25 (rate of heat-treated at 1250 F divided by rate of as-received specimen) had a ratio of 5 in the ferric sulfate-sulfuric acid test. Thus, in AISI 321 steel a sigma-type phase does lead to some increase in corrosion in this test.

TABLE V.—EVALUATION SEQUENCE[a]



[a] For all steels except those AISI-316 and 316L specimens which represent material intended for nitric acid service.

Proposal for an Evaluation Sequence

The testing procedure of Table V is suggested for consideration on the basis of the results described in the previous section. This sequence is proposed for 304, 304L, 316, 316L, and all other grades of austenitic stainless steels to which the ferric sulfate-sulfuric acid test is found applicable, except those type 316, 316L and 321 specimens which represent material intended for nitric acid service.

In order to simulate welding effects, the low-carbon grades are commonly heated for 1 or 2 hr at about 1250 F, the temperature of maximum chromium carbide precipitation, before exposure to the various evaluation tests (**11**). These sensitizing conditions are much more drastic than those which these steels encounter during welding. However, the effect of this drastic heat treatment is partially offset by the relatively high nitric acid test acceptance rate of 0.0020 in. per month, which is commonly used for 304L steel. There is considerable grain-dropping, that is, intergranular attack, on 304L steel having this nitric acid rate. In fact, any rate greater than about 0.0010 in. per month is evidence of grain-dropping in this test.

Rather than use an acceptance rate which permits an arbitrary amount of intergranular susceptibility in steels heated 1 or 2 hr at 1250 F it appears desirable to use a rate which separates those steels which drop grains in the evaluation tests from those which do not. In the nitric acid test, this rate is about 0.0010 in. per month, and in the ferric sulfate-50 per cent sulfuric acid test, it is about 0.0025 in. per month. Such acceptance rates can be used, if the heat treatment given the steels before testing more nearly approaches welding conditions. The 20-min heat treatment listed in Table V has been proposed for this reason.

Preliminary tests on type 304L steels in the nitric acid test (**19**) indicate that the evaluation results obtained with a 20-min heat treatment at 1250 F (in a salt pot[13]) combined with a 0.00090-in. per month acceptance rate are identical with those obtained with a 1-hr heat treatment at 1250 F and an acceptance rate of 0.0020 in. per month. The use of the shorter heat-treating time and lower acceptance rate also has a practical advantage. The percentage of specimens having acceptable oxalic acid etch structures is increased; that is, the number of specimens requiring the quantitative evaluation (ferric sulfate-sulfuric acid or other) test is reduced.

[13] Because the rate of heating and the control of temperature are more critical for the 20-min than for the 1-hr heat treatment, a salt pot should be used for the shorter heat treatment in place of the furnace usually employed for the 1-hr treatment.

Acknowledgment

The author wishes to thank S. J. Kucharsey of the Engineering Research Laboratory for assistance with this investigation.

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Engineering Materials Handbook

Edited by Charles L. Mantell; McGraw-Hill Book Co., New York, N. Y.; 1936 pp.; $21.50.

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HAROLD L. MAXWELL

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H. O. Wyckoff and F. H. Attix; National Bureau of Standards *Handbook 64*; 16 pp.; 20 cents; U. S. Government Printing Office, Washington 25, D. C.

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PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column

Among eminent authorities who will address the 51st Annual Meeting of the Air Pollution Control Assn. at the Sheraton Hotel, Philadelphia, May 25–29 are **Louis C. McCabe,** president, Resources Research, Inc., Washington, D. C., formerly head of the Los Angeles Air Pollution Control District and now consultant to the States Public Health Service; and **Morris Katz,** consultant to the Department of National Health and Welfare, Ottawa, Canada. Messrs. McCabe and Katz are chairman and vice-chairman respectively of ASTM Committee D-22 on Methods of Atmospheric Sampling and Analysis.

Several ASTM members and committee members were among those honored at the 54th annual convention of the American Concrete Inst. in Chicago in February. **Douglas McHenry,** director of development, Portland Cement Assn., and **Joseph W. Kelly,** professor and vice-chairman of civil engineering, University of California, were named ACI president and vice-president. **Bryant Mather,** chief, Special Investigations Branch, Concrete Div., Waterways Experiment Sta., Corps of Engineers, U. S. Army, Jackson, Miss., and **Cedric Willson,** vice-president and chief engineer, Texas Industries, Inc., Fort Worth, were elected to the Board of Directors of the Institute for 3-year terms. Mr. Mather currently is secretary of ASTM Committee C-9 on Concrete and Concrete Aggregates. Mr. Willson also serves on this committee. ACI honorary membership was conferred on **Douglas E. Parsons,** chief, Building Technology Div., National Bureau of Standards, Washington, D. C., and on **Stanton Walker,** director of engineering, National Sand and Gravel Assn. and National Ready Mixed Concrete Assn., Washington, D. C. Both are ACI past-presidents, with records of achievements for the Institute over long periods. Messrs. Parsons and Walker also have been very active in ASTM for many years; are former Directors and technical committee officers, and recipients of the ASTM Award of Merit in recognition of valued contributions.

Henry C. Ashley, assistant director of metallurgy, Chase Brass & Copper Co., Inc., has been appointed metallurgical director, Chase Metal Works plant, Waterbury, Conn.

Herbert J. Baker has retired as construction management engineer and project engineer, Construction Branch, U. S. Army, Europe.

David W. Boyd, formerly assistant general manager, has been appointed vice-president and general manager in charge of operations and sales, Engineering Castings, Inc., Marshall, Mich.

A. S. Brewer has retired as vice-president, NATCO Corp., Pittsburgh, Pa. Representing his company in the Society for many years, Mr. Brewer served on Committee C-15 on Manufactured Masonry Units.

Victor Brown, an executive vice-president of Kropp Forge Co., Chicago, Ill., has been elected president and general manager of Kropp Steel Co., the firm's wholly owned subsidiary at Rockford, Ill.

K. P. Campbell, superintendent of metallurgy, Armco Steel Corp., Sheffield Steel Div., Houston, Tex., has been appointed manager of the Houston plant. Mr. Campbell is active in the ASTM Southwest District Council.

D. W. Carswell has retired from the technical staff of The Texas Company, New York City. Mr. Carswell represented his company since 1940 on Committee A-1 on Steel and its Subcommittee IX on Steel Tubing and Pipe.

Charles A. Chabot, formerly research director, has been elected vice-president, Peters Manufacturing Co., Wollaston, Mass. He will head the Research and Development Division.

P. M. Christensen, director, Federal Pacific Electric Co. (formerly Fed. Elec. Products Co.), Newark, N. J., is now coordinator of engineering. He will formulate policy for the engineering, development, and testing departments.

Ralph A. Clark, manager, foundry service, Electro Metallurgical Co., Div. Union Carbide Corp., Cleveland, Ohio, has been awarded the Thomas W. Pangborn Medal by the American Foundrymen's Society "for outstanding contributions to the Society and ferrous casting industry, especially in the field of gray iron metallurgy."

Robert W. Cline, ceramist for a number of years with Onondaga Pottery and Syracuse China Corp., Syracuse, N. Y., presently is with the Ceramic Laboratories of the Division of Mineral Technology, University of California, Berkeley. He is working on a project concerned with metal to ceramic bonds, which is sponsored by the Atomic Energy Commission. Mr. Cline has been secretary of ASTM C-21 on Ceramic Whitewares and Related Products since 1956.

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Walter Collins recently retired as chief, engineering services, New York Central System, New York City. Mr. Collins had represented his company for many years in the Society and on several of the committees concerned with ferrous metals. He had been especially active in Committee A-1 on Steel, serving on many of the subcommittees, and representing the main committee on coordinating groups. He was vice-chairman of Committee A-1 for three years and chairman from 1956 to 1958. He served with the group concerned with railway car journal lubrication of Technical Committee B of Committee D-2 on Petroleum Products and Lubricants, also on Technical Committee F on Diesel Fuels; and with subgroups of Research Divisions concerned with spectrographic analysis of lubricating oils, and electron microscopy. He represented his company on Committee D-7 on Wood for the past 14 years.

M. A. Cordovi, formerly with The Babcok & Wilcox Co., Atomic Energy Div., is now affiliated with International Nickel Co., New York City. Mr. Cordovi is a member of ASTM Special Administrative Committee on Nuclear Problems, former secretary of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, and currently chairman of the A-10 subcommittee concerned with specifications for nuclear reactor structural materials.

Achilles W. Coutris has established a consulting engineering firm at 62, Rue Spontini, Paris, France. He formerly had been structures and foundation engineer for special projects and problems on the staff of Moran, Proctor, Mueser & Rutledge, consulting engineers in New York City. Mr. Coutris had performed analytical studies for a wide variety of projects which included certain advance warning radar stations.

Clarence R. Eckert retired as director of research, The Ruberoid Co., South Bound Brook, N. J. A member of the Society for more than 30 years, Mr. Eckert had represented his company on Committees C-11 Gypsum and D-8 on Bituminous Waterproofing and Roofing Materials.

W. O. English, formerly plant manager, Phoenix Manufacturing Co., Catasaqua, Pa., has been appointed divisional manager, Flange and Forging Division.

ASTM Past-President **C. H. Fellows** has retired as director, Engineering Laboratory and Research Dept., The Detroit Edison Co., Detroit, Mich. Mr. Fellows has been active in administrative and technical phases of the work of the Society for the past 30 years. He served as a member of the Executive Committee from 1940 to 1942; as Director from 1949 to 1952; as Vice-President from 1953 to 1955; and as President from 1955 to 1956. He has been very active in the Detroit District Council since 1935, serving terms as secretary, vice-chairman, and chairman. He is a past-chairman of the Administrative Committee on District Activities. Mr. Fel-

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lows has an outstanding record of service on many of the Society's technical committees including Committees A-5 on Corrosion of Iron and Steel, D-2 on Petroleum Products and Lubricants, D-9 on Electrical Insulating Materials, and D-19 on Industrial Water. He was particularly active in the Joint Committee on Boiler Feedwater Studies, having served both as chairman and secretary of this group, and being one of those who maintained its active and productive program. As a Past-President Mr. Fellows is a member of the current Board of Directors of the Society.

Walter V. Fox retired as a member of the technical service staff, Fox Chemical Service, Inc., Hyattsville, Md.

Alice J. Gitter, formerly with Whittaker Clark, & Daniels, Inc., is now director of market research, United Mineral and Chemical Corp., New York City. Miss Gitter is a former secretary of Committee C-21 on Ceramic Whitewares and Related Products. She also is a member of the recently organized Committee C-23 on Sorptive Mineral Materials.

E. J. Grajeck, formerly chief chemist, Collins & Aikman Corp., Albemarle, N. C., is now research chemist, Althouse Chemical Co., Div. of Crompton & Knowles Corp., Reading, Pa.

Erik Hagglund has been elected president, The Kanthal Corp., Stamford, Conn. He had been executive vice-president.

John L. Hague, National Bureau of Standards, Washington, D. C., received the Silver Medal Meritorious Service Award of the U. S. Department of Commerce "for outstanding original contributions to methods of analysis necessary for controlling the production of complex metal alloys." Mr. Hague is active in ASTM Committee E-3 on Chemical Analysis of Metals, currently serving as chairman of the Editorial Subcommittee, and as vice-chairman of the Ferrous Metals Division."

Robert W. Hunt Co., consulting inspection and research engineers, after 44 years at 175 W. Jackson Blvd., Chicago, Ill., have moved to new headquarters at 810 S. Clinton St. The company's ASTM membership dates from 1899, and through the years many of the company's personnel have been active in the work of the Society. **H. H. Morgan,** president, who has been 54 years with the company, is an ASTM Past-President and Honorary Member. **S. Blake Roberts,** district manager for the Hunt Co. in St. Louis, and a past-officer of the ASTM St. Louis District Council, served as treasurer of the General Committee on Arrangements for ASTM 1958 Committee Week.

Edgar W. Jones, formerly development engineer, Bruce Products Corp., Detroit, Mich., is now plant superintendent, Horace G. Preston Co., in the same city.

W. F. Kasper has retired as president, Fairmont Railway Motors, Inc., Fairmont, Minn.

John W. Keith retired as chief chemist, The Texas Co., Port Neches, Tex.

George P. Krumlauf, metallurgical engineer, Pig Iron & Coal Chemicals Div., Republic Steel Corp., Cleveland, Ohio, has been appointed assistant to the Division's sales manager.

Orla A. Larsen retired as chief chemical engineer, F. L. Smidth and Co., New York City.

Harry Majors, Jr., formerly on the faculty of the University of Alabama, is professor and head of mechanical engineering, Seattle University, Seattle, Wash.

James D. Malcolmsen has retired as consultant, Robert Gair Div., Continental Can Co., Inc., New York City. He had served for many years on Committees D-6 on Paper and Paper Products and D-10 on Shipping Containers. Mr. Malcolmsen resides at 930 Grizzly Peak Blvd., Berkeley, Calif.

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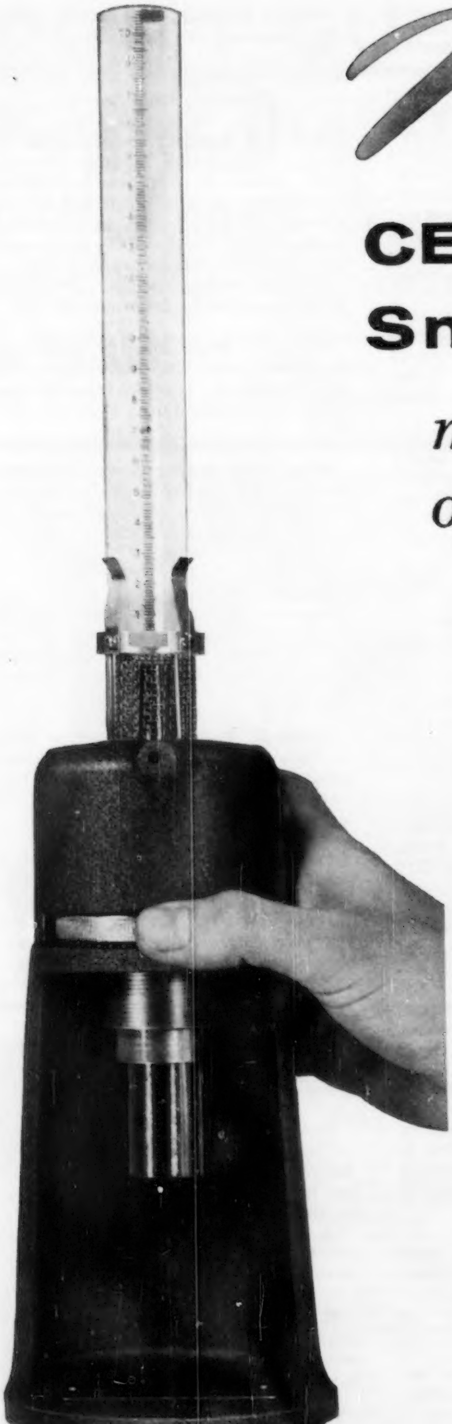

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FOR FURTHER INFORMATION CIRCLE 850 ON READER SERVICE CARD

(Continued from page 96)

George Manov, formerly technical assistant for the U. S. Atomic Energy Commission, has joined Tracerlab, Inc., as technical director of the reactor monitoring center in Richmond, Calif. Dr. Manov is internationally known for his work in isotope applications and in the nuclear field. In ASTM he has been very active in Committee E-10 on Radioisotopes and Radiation Effects. He was the first chairman (1951–1952) of this group, and for some years has been an honorary chairman of the committee.

O. W. McMullan, formerly chief metallurgist, has been appointed director of research and development, Bower Roller Bearing Div., Federal-Mogul-Bower Bearings, Inc., Detroit, Mich.

Charles E. Miller retired as packaging and loading engineer, United States Steel Corp., Pittsburgh, Pa. Mr. Miller represented his company on Committee D-10 on Shipping Containers for many years.

Kenneth J. Miller, until recently director of research, Vulcanized Rubber and Plastics Co., Morrisville, Pa., is now technical director, Molded Rubber Specialties, Inc., Painesville, Ohio.

William J. Morgan, formerly laboratory supervisor, Krouse Testing Machine, Inc., Columbus, Ohio, has accepted a position as staff metallurgist, Clinton Machine Co., Clinton, Mich.

B. R. Nijhawan, director, National Metallurgical Laboratory, Jamshedpur, India, was given the award of "PADMA SHRI" by the President of the Union Republic of India at the last Republic Day, January 26, 1958, in recognition of his exceptionally distinguished services in the fields of science in India.

Ralph B. Norton, research engineer of Kerite Co., Seymour, Conn., is now serving in the capacity of chief engineer.

T. F. Olt, director, Research Laboratories, Armco Steel Corp., Middletown, Ohio, has been elected vice-president of research. Mr. Olt has been active in several of the committees concerned with ferrous metals and is a former member of the Ohio Valley District Council.

L. B. Parsons, vice-president and director of research and development, Lever Brothers Co., Edgewater, N. J., has been elected to the board of directors of his company.

George Perrins retired from the engineering staff, Bullers, Ltd., Milton, Stoke-on-Trent, Staffordshire, England.

James P. Poole, research director of Brockway Glass Co., Brockway, Pa., was recipient of the 1957 Chesterman Award of the American Bottlers of Carbonated Beverages. He was cited for his research and development work on a process of surface coating glass containers with silicones for protective purposes. Mr. Poole serves on ASTM Committee C-14 on Glass and Glass Products.

Stanley L. Proud, until recently materials engineer, Wyatt C. Hedrick Co., Ocean Gate, N. J., is now senior materials engineer, Raymond Concrete Pile Co., Pereira, Colombia, South America.

George A. Rahn retired as materials engineer, Pennsylvania Turnpike Commission. After a thorough rest he will consider another activity. A member of the Society for many years, and active in Committees A-1 on Steel, C-9 on Concrete and Concrete Aggregates, and D-4 on Road and Paving Materials, Mr. Rahn plans to continue his interest in ASTM.

Harry E. Rapp, formerly consultant, Benjamin Foster Co., Philadelphia, Pa., is now technical director, Insul-Fil Div., Miracle Adhesives Corp., Bellmore, L.I., N. Y.

Gerald J. Ray has been named president, The Borden Chemical Co. of Canada, Ltd., West Hill, Canada. He was previously general manager, American Resinous Chemicals of Canada, Ltd., in Toronto.

Robert F. Rea has joined the Ceramic Division of the Champion Spark Plug Co. Detroit, Mich., as assistant director of research. He was formerly with Diamonite Products Div., United States Ceramic Tile Co.

James K. Richardson retired as chief, mechanical branch, U. S. Bureau of Reclamation, Denver, Colo. He had represented the Bureau of Committee A-3 on Cast Iron.

Frederick D. Rossini, head of the department of chemistry at Carnegie Institute of Technology, Silliman professor of chemistry, and director of the chemical and petroleum research laboratory, was honored by the Pittsburgh Junior Chamber of Commerce as recipient of its Special Award for contributions to industrial and civil progress. Professor Rossini has been active in ASTM Committee D-2 on Petroleum Products and Lubricants. He was the 1953 ASTM Marburg Lecturer.

Howard J. Rowe, chief metallurgist, Fabricating Div., Aluminum Company of America, Pittsburgh, Pa., has been awarded the William H. McFadden Gold Medal by the American Foundrymen's Society "for outstanding contributions to the Society and the light metals branch of the castings industry."

H. A. Russell, technical assistant to works manager, The Pantasote Co., Passaic, N. J., has been elected vice-president in charge of research and development.

Howard H. Seliger, National Bureau of Standards, Washington, D. C., received the Silver Medal Meritorious Service Award of the U. S. Department of Commerce "for major contributions in the field of liquid scintillation counting of beta-emitting radioactive nuclides and for meritorious authorship." Mr. Seliger serves on ASTM Committee E-10 on Radioisotopes and Radiation Effects.

(Continued on page 100)

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(ASTM Proc., Vol. 55, 1955)

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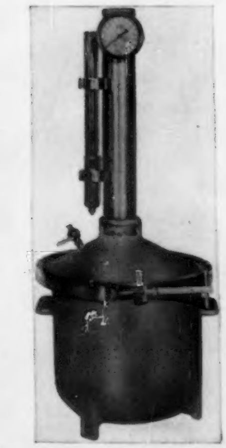

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FOR FURTHER INFORMATION CIRCLE 852 ON READER SERVICE CARD

(*Continued from page 98*)

Joseph M. Sexton has been named general manager of Societe Kellogg, the M. W. Kellogg Co.'s Paris subsidiary. Mr. Sexton formerly was manager of purchases at Societe Kellogg, a position he held since 1956 when the subsidiary was formed.

Robert S. Shane, formerly manager, Chemistry and Ceramics Section, Reactor Engineering Dept., Commercial Atomic Power Activities, Westinghouse Electric Corp., Pittsburgh, Pa., is now nucleonics specialist, Bell Aircraft Corp., Buffalo, N. Y.

Thomas W. Sheehan retired as city engineer, City of Malden (Mass.)

Arthur L. Shields is retiring as section manager, Materials and Process Engineering, Westinghouse Electric Corp., Springfield, Mass.

Franklin Allen Simmons, until recently with the Bridge Dept., West Virginia State Road Commission, Charleston, is now bridge design engineer, Arizona Highway Dept., Phoenix.

Ward F. Simmons has been appointed chief, High-Temperature Metals Research Div., Battelle Memorial Institute, Columbus, Ohio. Mr. Simmons represents the Institute on Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, and serves on the Data and Publications Panel of the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals.

ASTM Honorary Member **Frederick W. Smither,** retired chemist, National Bureau of Standards, received the first award of ASTM Committee D-12 on Soaps and Other Detergents for outstanding achievements in the field of soap and detergent technology. Presentation was made at the 1958 annual meeting of the Committee in New York City on March 11. The citation recognized Mr Smither's pioneering accomplishments and long-continued services in the Committee's work of developing standards in the detergents field. Mr. Smither was chairman of Committee D-12 from 1948 to 1950, and has been honorary chairman since that time.

W. V. Sternberger has retired as chief metallurgist, Motor Products Corp., Detroit, Mich.

Jesse W. Stillman recently retired as supervisor, Physical and Analytical Div., Central Research Dept., E. I. du Pont de Nemours and Co., Inc., Wilmington, Del. Dr. Stillman had served as chairman of Subcommittee 14 on Correlation of Chemical Analysis of Committee E-1 on Methods of Testing. He also has been very active in Committee E-3 on Chemical Analysis of Metals, serving as secretary from 1944 to 1950, and as chairman for the succeeding four years. Dr. Stillman rendered valued aid in the editing of the latest revision (1956) of ASTM Methods for Chemical Analysis of Metals.

Earl R. Stivers has retired as director, Package Research Laboratory, Rockaway, N. J. Affiliated with ASTM since 1933, Mr. Stivers, who plans to continue his membership, received an ASTM Award of Merit in 1953, recognizing valued contributions to the work of Committee D-10 on Shipping Containers. He served as secretary of the committee from 1936 to 1951, and for some time has served as vice-chairman of this main group. Mr. Stivers resides at 26 Rockaway Ave., Rockaway, N. J. After June 1 he and Mrs. Stivers will be living in Florida, as he has accepted an appointment as professor of engineering and business manager of the recently organized Manatee Junior College in Bradenton, Fla.

Jerome Strauss has retired as vice-president of Vanadium Corporation of America after 30 years of service. Active in metallurgical service for over 40 years, he was in 1953 the ASTM Gillett Memorial Lecturer, and in 1955 the Burgess Memorial Lecturer of the Washington Chapter of ASM. In that same year he received the Honor Award from his alma mater, Stevens Institute of Technology. During the course of guiding research for Vanadium Corporation he was responsible for the initiation of the low-alloy high-strength plate and sheet steels in originating "COR-TEN," and through the medium of the GRAINAL alloys which he developed began what are now commonly referred to as the boron-treated steels. Patents

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were issued to him on both of these developments. Mr. Strauss plans to undertake a limited amount of consulting work both here and abroad. A member of ASTM since 1916, and a former Director of the Society, Mr. Strauss has been chairman of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys since its organization in 1929. In 1953 he received the ASTM Award of Merit in recognition of faithful and distinguished service.

Leslie Wayne Teller retired as chief, structural research section, physical research branch, Bureau of Public Roads, U. S. Department of Commerce, Washington, D. C. A member of the Society for more than 30 years, Mr. Teller has been very active in the work of Committee C-9 on Concrete and Concrete Aggregates, serving as chairman from 1952 to 1954.

Howard R. Thomas retired as mechanical engineering consultant, U. S. Department of the Navy, Mine Countermeasures Sta., Panama City, Fla.

Lucien R. Vianey, until recently research engineer, United States Steel Homes, Inc., Harrisburg, Pa., has accepted a position as technical director, The Eaton-Dikeman Co., Mt. Holly Springs, Pa.

H. O. Weber retired as a member of the staff of the Tennessee Valley Authority. He had represented the Authority for a number of years on Committee B-1 on Wire for Electrical Conductors and several of its subcommittees.

Clyde Williams, formerly president of Battelle Memorial Inst., recently announced the formation of a new company to assist boards of directors and top management of industrial corporations with broad technical and business problems. The new firm, to be known as Clyde Williams and Co., will serve a wide range of industries in the United States and abroad and will have its central operations at 50 W. Gay St., Columbus, Ohio. Dr. Williams continues to serve Battelle as a member of the board of directors and in a consulting and advisory capacity. Dr. Williams will give the 1958 ASTM Gillett Lecture at the Annual Meeting in June. His subject will be "High-Temperature Metals in the Jet Age—Their Requirements, Properties, and Supply."

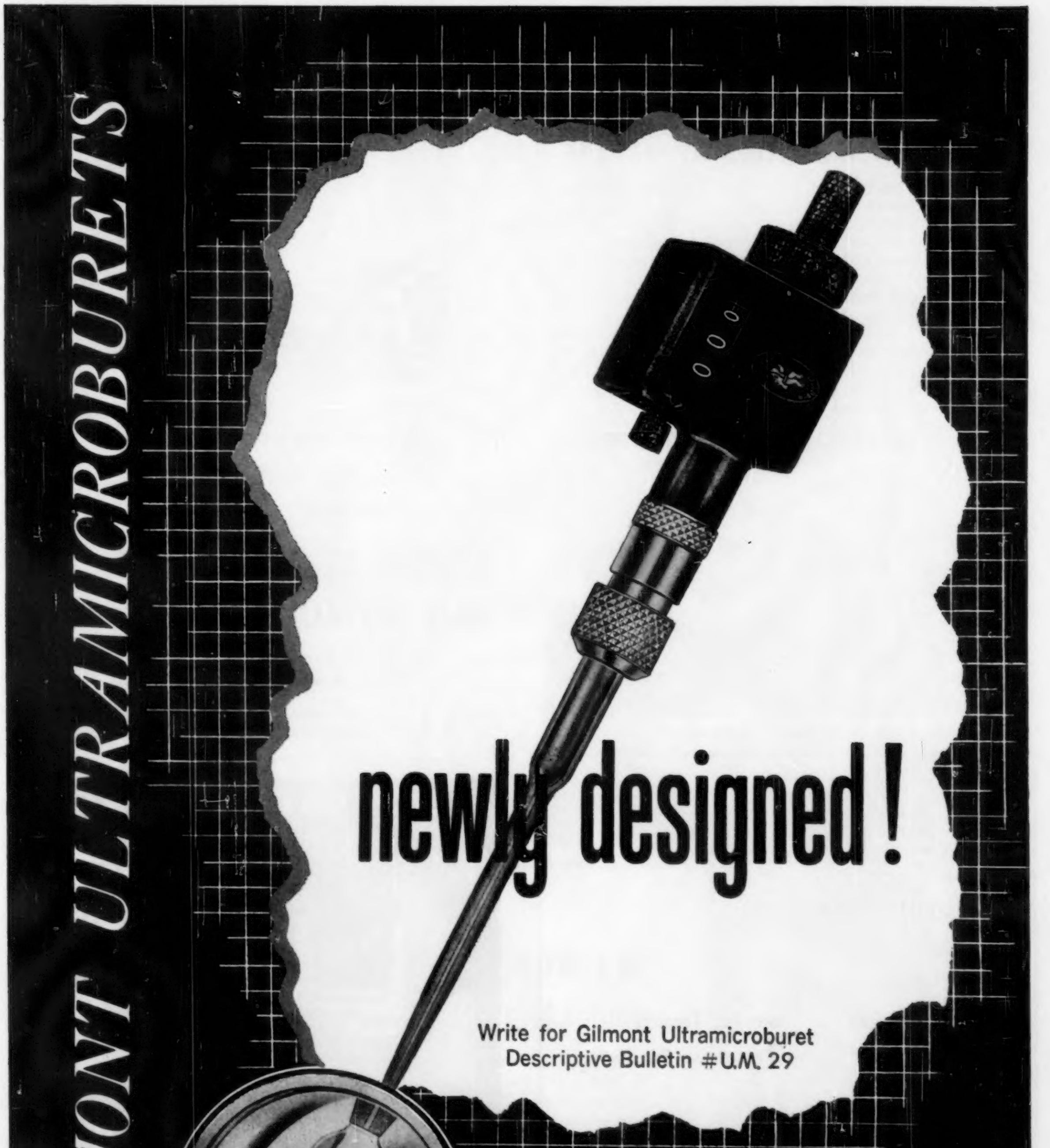
George C. Wilsnack retired as research director, Ideal Cement Co., Fort Collins, Colo. A member of the Society for 35 years, Mr. Wilsnack served over a long period on Committees C-1 on Cement, and C-17 on Asbestos-Cement Products.

T. Van Dyke Woodford, formerly with Chicago Fly Ash Co., Chicago, Ill., is now on the engineering staff of Walter N. Handy Co., Evanston, Ill.

W. A. E. Woods has retired as president of the Texas Steel Co., Fort Worth, Tex.

Richard C. Wright has been elected vice-president, Iron Fireman Manufacturing Co., Cleveland, Ohio. He was formerly chief engineer in charge of research and development.

LeRoy L. Wyman, head, Chemical Metallurgy Section, Metallurgy Div., National Bureau of Standards, received the Silver Medal Meritorious Service Award of the U. S. Department of Commerce "for original contributions to alloy theory and to the design and production of important ordnance items." A long-time member of the Society, Mr. Wyman has served on many of the metals committees. Currently he serves as chairman of Committee E-4 on Metallography, and as vice-chairman of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys. He also is a former chairman of the Administrative Committee on Simulated Service Testing, and presently is serving on the Administrative Committee on Papers and Publications.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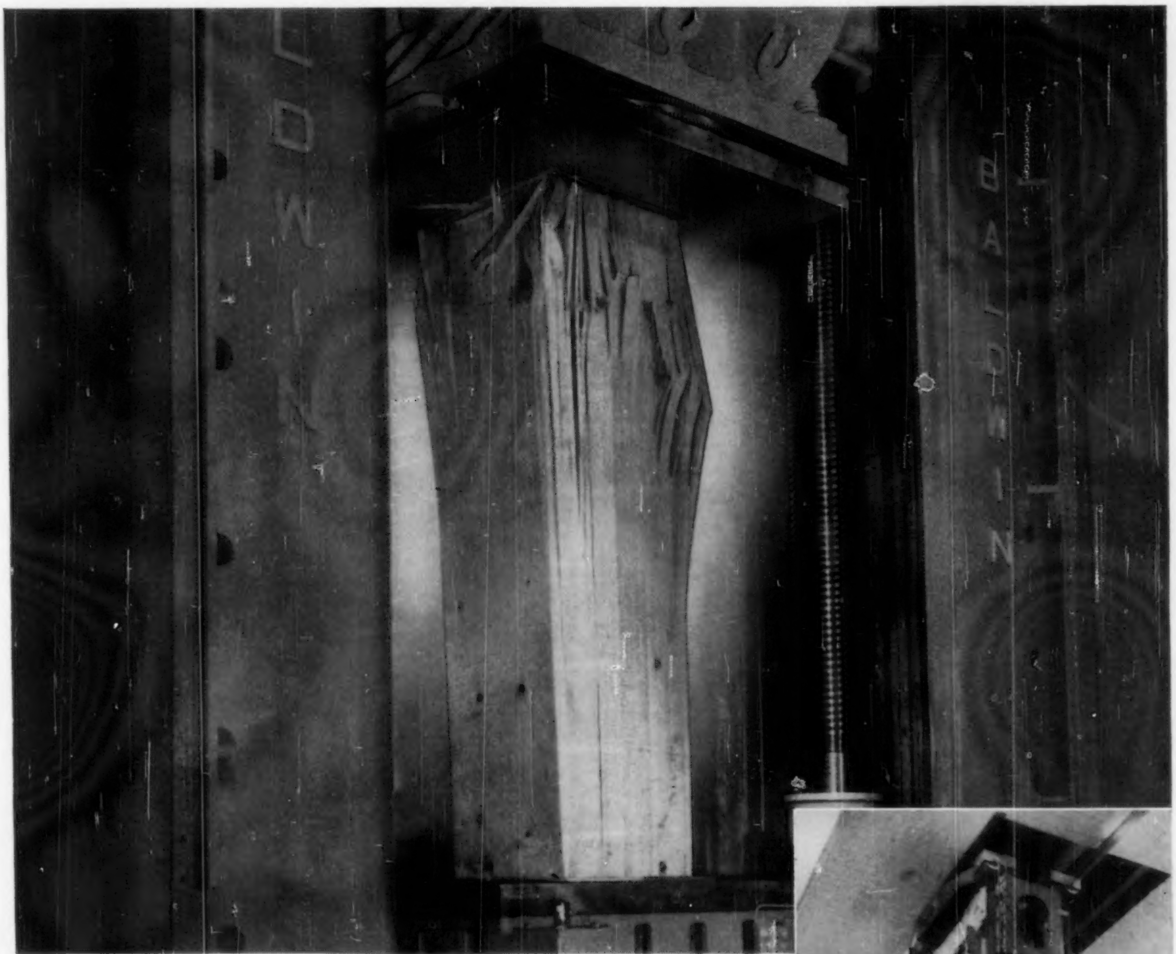

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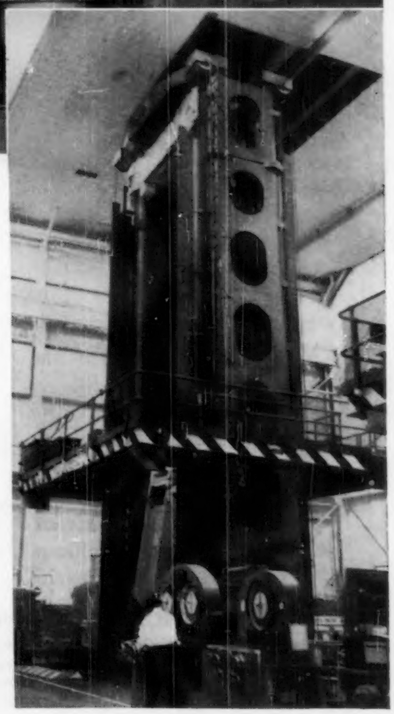

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DEATHS...

Comfort A. Adams, professor of engineering, emeritus, Harvard University; consulting engineer; 417 W. Price St., Philadelphia, Pa. (February 21, 1958, at the age of 89). A member of ASTM since 1920, and of Committee E-7 on Nondestructive Testing since 1938. Distinguished as an educator and engineer, and internationally recognized in the electrical and welding areas, Dr. Adams was an active member of the engineering faculty at Harvard University from 1891 until 1936; and through the years served as consulting engineer for many large companies including American Tool & Machine Co., Okonite Co., Babcock & Wilcox Co., General Electric Co., and Edward G. Budd Mfg. Co. The recipient of many honors and awards, and author of numerous papers, he was active in a number of professional and technical organizations. He was director of the American Bureau of Welding for many years, also served as chairman of the Welding Research Council of the Engineering Foundation. He took a very important part in the discussions leading to the organization of the Engineering Standards Committee, the predecessor of the American Standards Assn.

J. W. Bennett, chief engineer, Western Massachusetts Electric Co., Springfield, Mass. (September 9, 1957). Member since 1945.

Lewis K. Breeze, director of research, Glascote Products, Inc., Cleveland, Ohio (December 6, 1957). Member since 1953, serving on Committee C-22 on Porcelain Enamel, and Subcommittees I on Research and V on Finished Products.

V. B. Burgess, chemist, Chemical Labs., Philadelphia Electric Co., Philadelphia, Pa. (January 9, 1958). Represented his company since 1953 on Committee D-9 on Electrical Insulating Materials; also served for a number of years on Section E on Determination of Elements in Fuels of Research Division III on Elemental Analysis of Committee D-2 on Petroleum Products and Lubricants.

Edward Thomas Davis, partner, The Chester Engineers, Pittsburgh, Pa. (February 6, 1958). Member since 1952.

W. R. Fraser, experimental engineer, Michigan Consolidated Gas Co., Detroit, Mich. (January 29, 1958). Member since 1937. Represented American Gas Assn. since 1945 on Committee D-3 on Gaseous Fuels; also served for many years on Section II on Liquefied Petroleum Gas of Technical Committee H on Light Hydrocarbons of Committee D-2 on Petroleum Products and Lubricants.

Mr. Fraser was a member of the Detroit District Council for the past ten years; he served as chairman of this group from 1950 to 1952.

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Frank X. Gilg, executive assistant, Boiler Div., The Babcock & Wilcox Co., New York City (January 26, 1958). Representative of the Sustaining Membership of his company for many years. As an active participant in the work of the ASME Boiler Code Committee, Mr. Gilg was well known to a number of ASTM members.

G. B. Hatch, supervisor, Technical Literature Research Dept., The Texas Co., Beacon, N. Y. (De ember, 1957). Representative of company membership for a number of years.

T. D. Hayes, manager, Bar and Semifinished Materials Bureau, United States Steel Corp., Chicago, Ill. (October 12, 1957). Member since 1945.

Arthur H. Jameson, retired manager of casting sales, Malleable Iron Fittings Co., Branford, Conn. A graduate of the Massachusetts Institute of Technology (Chemical Engineering, 1893) Mr. Jameson died February 3, 1958, in his 88th year. Affiliated with ASTM since 1917, Mr. Jameson was a very active and loyal member. He served for many years, until his retirement, on a number of the metals committees including A-1 on Steel, A-3 on Cast Iron, former A-4 on Heat Treatment of Iron and Steel, and A-7 on Malleable-Iron Castings. He also was a member of the American Institute of Mining and Metallurgical Engineers, The American Iron and Steel Institute, and the American Foundrymen's Society.

W. R. Kuenzel, director of fabric development, Deering, Milliken and Co., Inc., New York City (October, 1957). Representative of the company's Sustaining membership, Mr. Kuenzel had served for many years on Committee D-13 on Textile Materials, and several of its subcommittees.

R. A. Moyer, foreman, physical testing, The Carpenter Steel Co., Reading, Pa. (February, 1958). Represented his company since 1954 on Subcommittee V on Mechanical Tests of Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys; also served on several subcommittees of Committee E-1 on Methods of Testing.

William M. Piatt, consulting engineer, Piatt & Davis, Durham, N. C. (May 1, 1957). Member since 1940.

Geoffrey William Preston, general manager, Copper Development Assn., London, England. Member since 1938.

Carey F. Ramey, for many years chief chemist, also assistant manager, Product Acceptance Dept., Standard Oil Co. of California, San Francisco (October 5, 1957). A member of the Society for 23 years, Mr. Ramey was very active for many years in Committees D-1 on Paint, Varnish, Lacquer, and Related Products, D-2 on Petroleum Products and Lubricants, and D-16 on Industrial Aromatic Hydrocarbons and Related Materials. He also participated in ASTM district activities and played an active part in the first Pacific Area Meeting of the Society in San Francisco in 1949.

J. H. Romann, consulting engineer; for many years on the technical staff of Tube Turns, Inc., Louisville, Ky. (December 16, 1957). For many years personal member of the Society; also representative of Tube Turns, Inc., on Committee A-1 on steel and several subcommittees from 1939 to 1957. Mr. Roman served on the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals, and from 1942 till the time of his death was a member of ASA Sectional Committee B36 on Standardization of Dimensions and Materials of Wrought-Iron and Wrought-Steel Pipe and Tubing.

A. K. Steger, president, Hanford Foundry Co., San Bernardino, Calif. (June, 1957). Member since 1954.

J. Binford Walford, architect, Richmond, Va. (August, 1956). Member since 1951.

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Hanson, Clarence P., construction engineer, Department of Public Works, City of St. Paul, 234 City Hall, St. Paul 2, Minn.

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Schlueter, Jack S., research engineer, Continental Can Co., Inc., Conolite Research Dept., 4300 N. Port Washington Rd., Milwaukee 12, Wis.

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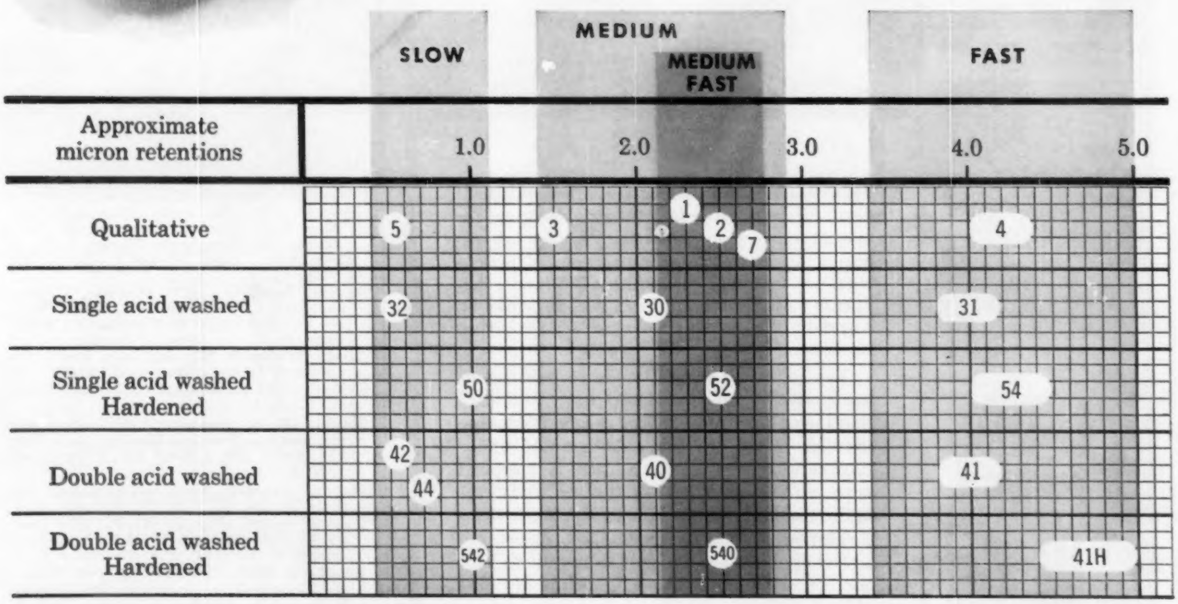

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FOR FURTHER INFORMATION CIRCLE 879 ON READER SERVICE CARD

(*Continued from page 120*)

Lake Ontario Portland Cement Co., Ltd., A. J. Anderson, executive vice-president and general manager, Box 620, Picton, Ont., Canada.

Public Power Corp., Loukianou 5, Athens, Greece.

Resintela, Resinas Sintéticas, Lda., J. Rosman, plant manager, Rio de Mouro, Portugal.

Solvay et Cie., Marcel Rossignol, director of central lab., 33 rue Prince Albert, Brussels, Belgium.

Administracion Ferrocarriles del Estado, Way and Works Dept., Calle La Paz 1095, Montevideo, Uruguay.

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Kuhfeldt, Robert G., maintenance engineer, Empresa Colombiana de Petroleos, Barrancabermeja, Colombia. For mail: Ecopetrol-Oleoducto, Barrancabermeja, Colombia.

Lindberg, Richard E., civil engineer, Area Public Works Office, U. S. Department of the Navy, Navy 926, San Francisco Calif. For mail: Box 35, Agana, Guam.

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Singapore Polytechnic, The Principal, Box 2023, Singapore, Malaya.

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Wallis, Patrick Brian, engineer-in-charge, mechanical testing, Henry Wiggin and Co., Ltd., Holmer Rd., Hereford, England.

Wright, J. M., manager, technical dept., Cable Makers Australia Pty., Ltd., Liverpool, New South Wales, Australia.

Wylie, R. B. F., director, Copper Development Assn., 55 S. Audley St., London, W. 1, England.

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58-1

FOR FURTHER INFORMATION CIRCLE 881 ON READER SERVICE CARD

NEWS NOTES ON
Laboratory Supplies and Testing Equipment

Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses. The Society is not responsible for statements advanced in this publication.

LABORATORY ITEMS

Recording Balance—Now available as a completely new instrument: An automatic recording, analytical balance which shows instantaneous weight and rate of weight change.
Wm. Ainsworth & Sons, Inc. **1545**

Vibrator—Pretesting of parts and assemblies weighing up to 10 lb can be done under shakedown conditions with a new vibration-fatigue testing machine. Vibration is produced on a vertical plane, in simple, harmonic motion.
All American Tool & Mfg. Co. **1546**

Freezing-Point—Designed to provide a rapid, dependable method for determining osmotic pressure, molecular weight of many water-soluble compounds, and the molecular weight of many organic compounds in benzene.
American Instrument Co., Inc. **1547**

Creep Tester—A new model creep-rupture testing machine is available. Called the "New M" creep-ruture tester, the new model replaces the former M machine. It offers improvements over the older model and is engineered to meet the needs of many creep laboratories which test smaller size specimens or use lighter loads.
Arcweld Mfg. Co. **1548**

Ultrasonic Component—Oscillator, PG-650 is a variable frequency pulse modulated R. F. source for applications requiring high power output as well as extreme stability.
Arenberg Ultrasonic Lab., Inc. **1549**

Spectrograph—A research spectrograph can now be used as a production control instrument in the metals industry. An interchangeable direct-reading attachment for a high-resolution spectrograph is available.
Baird-Atomic, Inc. **1550**

Scaler—A new general-purpose, high-speed, glow-tube scaler, Model 132, has been developed. This Multiscaler II features universal high-speed counting for use in industrial research.
Baird-Atomic, Inc. **1551**

Testing Machine—A new 150,000-lb universal testing machine can apply tension and compression or alternating loads to a specimen, and is capable of providing facilities for both standard testing and alternating load work.
Baldwin-Lima-Hamilton Corp. **1552**

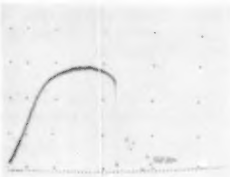
Electronic Integrator—A new electronic integrator with an extremely fast counting rate is announced. It is developed for use in chromatographic applications to measure the relative quantity of components in gas mixtures.
Barber-Colman Co. **1553**

(Continued on page 126)

WHAT HAPPENS TO YOUR MATERIALS

at deformation rates of 1000, 2000, 6000 inches per minute – or higher?

Strength characteristics of materials subjected to high rates of loading have long been sought by designers who must critically consider *actual* safety factors, weight, volume, and cost. These "high rate" strength characteristics are even more anxiously sought after today, because demands on materials and structures are being increased to keep pace with both military and civil technology.



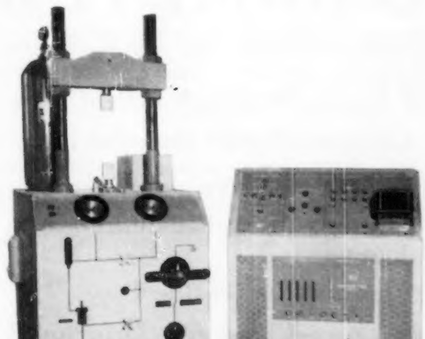
120 INCHES PER MINUTE

6000 INCHES PER MINUTE

This need has led to the development of the Model 625B High Rate Tester at ALINCO. It consists of separate Loading and Recording Sections that can be located as much as fifty feet apart. Specimens can be strained at rates as high as 6000 inches per minute, and as low as 2 inches per minute. The 4-by-5-inch stress-strain record provided by the Recorder Section is calibrated in units of stress, strain, and time, as shown in the illustration.

It is now possible to choose materials and design structures realistically. *Quantitative* data (not extrapolated data) can be collected with the Model 625 at genuinely high rates of loading. The first record shows a stress-strain curve for a material strained at 120 inches per minute. The ultimate yield is 150 pounds. The next record shows the same material strained at 6000 inches per minute, and the ultimate yield is 210 pounds.

Although the Model 625B has been on the market for only a few months, several manufacturers are already using it to collect valuable data. Write today for detailed literature if your materials are subjected to high rates of loading.



ALINCO *Allegany Instrument Company, Inc.*

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3455 CAHUENGA BLVD.
HOLLYWOOD 28, CALIF.

FOR FURTHER INFORMATION CIRCLE 884 ON READER SERVICE CARD

(*Continued from page 124*)

Bench Comparator—Two major accessories, a Surface Illuminator and Protractor Ring, have been added to the standard bench comparator. The protractor ring consists of a fixed ring assembly, graduated ring, vernier scale, and clamp arrangement and the surface illuminator consists of a 50-w 115, v lamp, a fixed condensing lens system, a mirror, and a focusable projection lens.
Bausch & Lomb Optical Co. 1554

Thermal Conductivity—The availability of a new, industrial, thermal-conductivity, gas analyzer, *Model 76*, for the continuous monitoring of one constituent in a wide variety of combination gases is announced.
Beckman Instruments, Inc. 1555

Digital Voltmeter—An all-electronic digtal voltmeter designated Model 5350, measures d-c and a-c voltage and resistance to accuracies of 0.5 per cent.
Beckman Instruments, Inc. 1556

Gas Chromatography—New Model K-5 Kromo-Tog can analyze materials that boil up to 475 C and higher, including fatty acids, and other compounds containing as high as 36 carbon atoms and on into temperature regions as yet unexplored.
Burrell Corp. 1557

Oxidation Unit—The GFB-JRZ oxidation unit permits the precise determination of the amount of oxygen absorbed by rubber, plastic, fibers, or other materials which are subject to deterioration on exposure to air or oxygen. The unit can also be used as the heating unit for the test-tube aging procedure ASTM D 865-50 T.
G. F. Bush Associates. 1558

Micro Spectra Indicator—The GFB Spectra Concentration Indicator & Comparator, Model A.1, may be used for simultaneous display or recording of an optical-density variation (as in a spectrogram) on a comparator screen and any portion of this on another screen for concentration determinations instantly, and a standard on the comparator screen.
G. F. Bush Associates. 1559

Potentiometers—Eight standard resistance values (100 to 25,000 ohms) are manufactured with 20 ppm resistance wire and can dissipate more than ½ watt at 125 C for more than 2000 hr.
Carter Mfg. Corp. 1560

Pressure Pickup—A new pressure pickup, designed for applications where physical abuse is a problem, is available. Known as the Type 4-322 differential pressure pickup, it offers unusually rugged design combined with sensitive performance.
Consolidated Electrodynamics Corp. 1561

Gripping Fixtures—New, illustrated literature describing complete line of gripping fixtures for its full range of universal testing machines has been issued.
W. C. Dillon & Co., Inc. 1562

pH Measuring—Model 28A meter incorporates several features. An isopotential control system is used to effect fully automatic temperature compensation.
E. I. L. Instruments. 1563

Colorimeter—Colorimeter for reproducible color measurements in petroleum laboratories according to ASTM test D 1500 is available.
Fisher Scientific Co. 1564

Glossmeters—These instruments meet the requirements of ASTM, Federal, and TAPPI Specifications. Five available gloss-exposure heads will duplicate test conditions which have proved useful with different materials.
Gardner Lab., Inc. 1565

Laminagage—The Glennite Laminagage, Model FLW-I, can be used for the thickness measurements of metallic film or foil and it will detect surface and subsurface cracks in smooth and rough coatings, flat stock, or plate and tubing. In addition it can be used to measure coating thicknesses of odd-shaped pieces and on assembly lines where the thickness of coatings must be continuously monitored.
Gulton Industries. 1566

Torsional Damping Tester—Designed for investigating torsional elasticity and

(*Continued on page 128*)

(*Continued from page 126*)

damping effects in plastics, rubber, artificial leather, and similar materials by means of free oscillations.
Wm. J. Hacker & Co., Inc. 1567

Micrometer—New instrument used for measuring and checking the depths of internal "O" ring, retaining ring, and recess grooves to engineered specifications.
Illinois Metal Products. 1568

Spectrometer—A new direct reading spectrometer completes analysis of both ferrous and nonferrous metals and alloys within 30 sec—and instantly registers concentrations of up to 30 alloying elements simultaneously.
Jarrell-Ash Co. 1569

Penetrameter—Sensitivity gages for determining radiographic image quality. Penetrameters are made in all materials to meet the requirements of ASME, ASTM, MIL-I-6865A, and the new MIL-STD-271 radiographic code. Clean, round, straight-sided holes, and square edges.
Jem Penetrameter Mfg. Co. 1570

Atmosphere Furnace—A new, high-temperature, vertical-tube, atmosphere furnace has been announced.
Lindberg Engineering Co. 1571

Honeycomb Structures Testing—A completely new method for checking the bond in honeycomb structures is the latest development added to the group of testing systems.
Magnaflux Corp. 1572

Bridge Balance Unit—Model 438-B serves as a bridge between a transducer of one, two, or four-arm type strain gage and a recording oscillograph. It has provisions for completing any part of the bridge circuit not contained in the transducer, and for balancing the bridge and adjusting the sensitivity.
Midwestern Instruments. 1573

Particle Size—An M-S-A particle size analyzer, a general-purpose instrument for measuring size distribution of small particles at minimum cost, is announced. The new analyzer was designed for particles between approximately 0.1 and 40 microns.
Mine Safety Appliances Co. 1574

Radioactivity Gage—A new gage, the Model ASR-3, measures fluid density, specific gravity, or per cent solids in a liquid continuously and automatically with a full-scale range as narrow as 0.05 specific gravity units (7 Bé. 10 Tw. 20 API per cent solids) with a precision of ±2 per cent of range.
The Ohmart Corp. 1575

Panalyzor—A new panalyzor, Model SB-12a, Type T-100, has been introduced for measurement and analysis. Specifically designed for SSB investigations, the SB-12a offers increased dynamic range and many other new features.
Panoramic Radio Products, Inc. 1576

X-Ray Enhancement—An electronic instrument "Exicon" that increases the readability of X-ray negatives through contrast enhancement is the newest "tool" available to industrial radiographers.
Philco Corp. 1577

Flash Point Tester—A new automatic means for quickly and accurately indicating and recording flash points with range of 80 to 180 F is of particular interest to control laboratories, where quick and permanent ASTM D 56 flash points, yet operational simplicity, is required.
Precision Scientific Co. 1578

Magnetic Core Tester—Model 1100 magnetic-core tester recent in line of specialized pulse equipment for laboratory analysis and production testing of a wide range of magnetic materials is announced.
Rese Engineering, Inc. 1579

Hydraulic Fluid Tester—The hydraulic fluid test (pump method) is designed to facilitate the evaluation of all petroleum, synthetics, and water base fluids under fixed conditions of pressure, temperature, and time.
Research Appliance Co. 1580

Water Resistance Grease—ASTM Tentative Method D 1264–53 T—the apparatus number 100.1 is designed to provide the test equipment required for this method.
Roxana Machine Works. 1581

Durometer—Durometer is manually applied to the test specimen and the reading observed on the dial. The Shore "A" durometer conforms to ASTM D 676-55 T.
Shore Instr. & Mfg. Co., Inc. 1582

Unconfined Compression Testing—The availability in the U. S. of a new portable hand-driven machine for performing unconfined compression tests on soils has been announced. The machine includes a recording system that provides a permanent record of all tests performed.
Soiltest, Inc. 1583

Creep-Rupture Machine—New design provides dual loading ranges of 600 and 6000 lb using unique lever arrangement. Combination ball and cone joints coupled with parallel knife edges eliminate bending in specimen.
Steimer & Stiles. 1584

Coal Crusher Samplers—Coal crusher samplers are being utilized by an independent testing laboratory for the sampling of high-moisture bauxite for industrial use.
Sturtevant Mill Co. 1585

Potentiometer Pyrometer—With the addition of four new interchangeable special scales the pyrotest, portable, potentiometer, pyrometer can now be used to check and calibrate temperature instruments actuated by any one of 10 types of thermocouples.
Technique Associates, Inc. 1586

Furnaces—Four completely new utility-size electric bench-type furnace models, designated collectively as "Type 1300 Furnaces," all have the same chamber dimensions, case size, and general construction, but differ in voltage requirements (115 or 230) and in mode of temperature control.
Thermo Electric Mfg. Co. 1587

Thickness Tester—A new nondestructive coating-thickness tester, Dermitron Model D-2, has been developed. This portable instrument gives accurate and direct readings of virtually any coating on any base, including metal coatings (such as plating) on metal base; nonmetallic coatings (such as paint, anodizing, porcelain) on metal base; and metal films on nonmetallic base (plastics, ceramics).
Unit Process Assemblies, Inc. 1588

Vacuum Furnace—A newly designed laboratory vacuum furnace capable of attaining temperatures in excess of 2000 C has been announced.
Vacuum Equipment Div., New York Air Brake Co. 1589

Burner—A new blast burner, the Flame-Selectro, with 5 different tips mounted on a revolving turret; glass blower can dial any one of 5 different orifices from 1.5 through 6 mm in diameter.
Will Corp. 1590

CATALOGS & LITERATURE

Integrating System—Model 270 described in 4-page folder for time integral measurement of dynamic phenomena in research and quality control.
Allegany Instrument Co., Inc. 2357

Photometer—A 6-page bulletin, *No. 2295*, describing a new instrument which measures turbidity, dissymmetry, depolarization, and angular scattering is available.
American Instrument Co., Inc. 2358

IR-4 Accessories—A new catalog, *Bulletin 725*, of sampling equipment and other accessories for the Beckman IR-4 infrared spectrophotometer is now available.
Beckman Instruments, Inc. 2359

Hygrometer—A new 4-page bulletin, *EH-4001*, provides detailed information on the features, operation, and specifications of the portable, panel-mounted, and explosion-proof models of the hygrometer.
Beckman Instruments, Inc. 2360

Ovens—Four page, two-color brochure, *Bulletin No. 5720*, introduces seven new Blue M Ovens.
Blue M Electric Co. 2361

Pressure—Catalog 109 is now available for distribution. This eight-page, two-color brochure outlines force and pressure-measuring instruments for industrial applications.
Dynametrics Corp. 2362

Apparatus Catalog—A new 43-page catalog, *57G*, contains over 250 items including laboratory shakers, rotators, air pumps, cathetometers, electro analysis

apparatus, and stirrers featuring the hollow spindle. All items are fully described with prices and are illustrated with detailed wood cuts.
Eberbach Corp. 2363

Pneumatic Transducer—New catalog sheet *59-100* explains operation of pneumatic transducer, an electro-mechanical device for instantaneously converting 3–15 psi input pressures into a-c signals.
Fischer & Porter Co. 2364

Potential Measurement—*Catalog 17B-100* describes O-R-P cell and potentiometer-type recorder for measuring, indicating, and recording oxidation-reduction potential.
Fischer & Porter Co. 2365

Instrument Catalog—A new edition of the bulletin on testing instruments, *Bulletin No. 1400,* featuring instruments with complete automatic timing has been published.
W. & L. E. Gurley. 2366

Sieves—Catalog describes sieves and shakers used for testing aggregates, cement, coal, and other dry materials.
Humboldt Mfg. Co. 2367

Speedomax G—Concise information about electronic Speedomax G indicators and recorders for precise measurement of pressure, force, tension, and weight using load-cells is presented in a new illustrated 4-page data sheet *ND 46-20(1).*
Leeds & Northrup Co. 2368

Metallurgical Furnaces—Tensile, creep, and stress-rupture tests on steels and alloys can be made with accuracy in various models of high-temperature, electric furnaces. Described in folder.
Marshall Products Co. 2369

Vacuum Pumps—A new 16-page product summary and price list shows a complete line of standard and custom high-vacuum components, equipment, and systems.
National Research Corp. 2370

1958 Price List—A new price list, showing many additions to its line of nuclear instruments and accessories, is now available.
Nucleonic Corp. of America. 2371

X-Ray Microscope—A new 6-page Norelco folder, titled "A High-Resolution PMR X-ray microscope with electron microscope conversion," is available.
Philips Electronics, Inc. 2372

Apparatus Catalog—Volume 10, Number 1, 32-page book describes latest apparatus and methods.
E. H. Sargent & Co. 2373

Sample Cutter—Tensilkut machine used to cut samples of film, foil, or sheet metal is described in an 8-page folder.
Sieburg Industries, Inc. 2374

Concrete—A new 6-page bulletin on concrete-testing machines and accessory equipment has been issued.
Soiltest, Inc. 2375

Shaker Catalog—Products listed in a 60-page catalog, *No. 5712,* include flow-control valves, feeders, screens, parts feeders, lapping and polishing machines, selenium rectifiers and rectifier units, infrared heating elements and panels.
Syntron Co. 2376

Thermocouple Wires—A new, revised catalog, *No. 32,* on thermocouple and thermocouple-extension wires, is available.
Thermo Electric Co., Inc. 2377

Microwave Testing—A completely new 32 page, 2-color catalog describing microwave test equipment is available.
Weinschel Engineering Co. 2378

INSTRUMENT COMPANY NEWS

Harvey-Wells Electronics, Inc., Southbridge, Mass.—A new research and development facility has been set up in the Boston area. This new division will specialize in the development of commercial products for the Manufacturing Division and will also handle a certain amount of government and private development work.

The Research Appliance Co., Allison Park, Pa.—Manufacturer of specialties in research apparatus and air-pollution-sampling equipment announces the appointment of the William C. Buchanan Co. as their representative in the southern Louisiana and Texas area.

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Federal Government Standards Index Changes

The General Services Administration of the Federal Supply Service is charged with the responsibility for establishing specifications to be used by the Federal Government for procurement of materials and supplies. The GSA issues an annual Index of Initiation of Federal Specifications Projects, and monthly supplements.

The items listed below appeared in Supplements Nos. 10 and 11 for the months of December, 1957 and January, 1958.

INITIATIONS:

Title	Type of Action	Symbol or Number	FSC Code	FSSC Class	Assigned Agency & Preparing Activity
Crate, Wood (Open, Lightweight)	New	PPP-C-650	8115	..	DOD-Army-CE
Crate, Wood (Sheathed, Lightweight)	New	PPP-C-660	8115	..	DOD-Army-CE
Floor Plates, Steel, Rolled	Rev.	QQ-F-461	..	..	DOD-Navy-Ships
Insulation, Felt, Thermal, Mineral Wool (for Low Temperatures)	Am. 1	HH-I-542	..	..	GSA-FSS
Insulation, Thermal, Mineral Wool, Block or Board & Pipe Insulation (Molded Type)	Am. 1	HH-I-562	..	..	GSA-FSS
Packaging, Packing & Marking of Textile Fabrics (Woolens, Worsteds, Cottons, Silks, and Synthetics)	Rev.	PPP-P-51	8305	..	DOD-Army-QMC
Paint; Acrylic Emulsion Exterior	New	TT-P-0019 (Army-CE)	8010	52	DOD-Army-CE
Paint; Exterior Emulsion (for Masonry)	New New	TT-P-33a & TT-P-0033 (COM-NBS)	8010 ..	52 ..	COM-NBS ....
Paint; Styrene Butadiene Emulsion Exterior	New	TT-P-0099 (Army-CE)	8010	52	DOD-Army-CE
Paper, Kraft, Wrapping	New	UU-P-00268d (Army-GMC)	3135	53	DOD-Army-QMC
Sodium Orthosilicate, Technical	Rev.	P-S-651a	6810	51	DOD-Army-CmlC
Sodium Phosphate, Dibasic, Anhydrous	Rev.	O-S-639a	6810	..	DOD-Army-CmlC
Textile Test Methods	Am. 4 (part)	CCC-T-191b	8305	83	COM-NBS
Toluidine-Red-Toner; Dry (Paint Pigment)	Rev.	TT-T-562b	8010	52	GSA-FSS
Venetian—Red; Dry (Paint Pigment)	Rev. Rev.	TT-V-226b & TT-V-00226a (GSA-FSS)	8010	52	GSA-FSS
Wire, Steel, Carbon (Round, Bare & Coated	Int. Rev.	QQ-W-00461d (GSA-FSS)	9505	..	GSA-FSS

REASSIGNED PROJECTS:

Title of Specification	Type of Action	Symbol or Number	FSC Code	FSSC Class	Technical Committee or Former Agency Withdrawn from	Reassigned to
Paint: Polyvinyl Acetate Emulsion Exterior	New	TT-P-0055 (Army-CE)	..	..	COM-NBS	DOD-Army-CE

WITHDRAWALS:

Title of Specification	Type of Action	Symbol or Number	Assigned Agency of Technical Committee	Reason for Withdrawal
Boxes, Wood, Wire-bound	Am. 1	PPP-B-585	DOD-Navy-S&A	Spec. will be amended in lieu of revision.
Webbing, Elastic	Rev.	JJ-W-155a	DOD-Army-QMC	Withdrawn 1-31-58 by request of QMC because of extensive research which is essential before preparing draft.

PROMULGATIONS:

Title	Type of Action	Symbol or Number
Aluminum Alloy; Bars, Rods, and Shapes: Extruded; 6061 and 6062 (superseding FS QQ-A-270)	Rev.	QQ-A-270a
Aluminum Alloy Ingot (for Remelting) (superseding FS QQ-A-371b)	Rev.	QQ-A-371c
Aluminum Alloy Sand Castings	Am. 1	QQ-A-601b
Bags, Shipping, Cushioned	Am. 1	PPP-B-30
Bottles, Weighing (with Stoppers)	Am. 1	DD-B-620a
Flasks, Laboratory	Am. 1	DD-F-250
Inhibitor, Corrosion, Liquid Cooling System (superseding IFS O-C-00746a (GSA-FSS) & FSO-C-746)	New	O-I-490
Soap, Toilet (Floating White) (superseding IFS P-S-00616c (GSA-FSS) & FS P-S-616b)	Rev.	P-S-616d
Steel Bars, Carbon, Cold Finished and Hot Rolled, (General Purpose) (superseding FS QQ-S-633)	Rev.	QQ-S-633a
Veneer, Paper-Overlaid, Container-Grade	Am. 1	PPP-V-205
Wood-Preservative; Chromated Zinc Chloride (superseding IFS TT-W-00551a (GSA-FSS) & FS TT-W-551)	Rev.	TT-W-551b

INTERIM FEDERAL SPECIFICATIONS ISSUED:

Title	Type of Action	Symbol or Number
Ammonium Hydroxide, Technical	Rev.	O-A-00451c (GSA-FSS)
Insulation, Thermal, Asbestos, Block and Pipe-Covering (for Temperatures Up to 750 F)	Am.	HH-I-561c (GSA-FSS)
Pipet, Ostwald, Ostwald-Folin, and Ostwald-Van Slyke	New	DD-P-00386a (HEW-PHS)
Plastic Sheet, Laminated, Decorative, and Non-decorative	Rev.	L-P-00508a (GSA-FSS)
Soap, Grit (Hand, Paste, and Powder)	New	Std. 00120 (GSA-FSS)
Soap, Toilet, Liquid, and Paste	Rev.	P-S-00624d (GSA-FSS)
Toluidine-Red-Toner: Dry (Paint Pigment)	New	TT-T-00562a (GSA-FSS)
Venetian-Red, Dry (Paint Pigment)	New	TT-V-00226a (GSA-FSS)
Wax, General Purpose, Solvent Type	New	P-W-00158a (GSA-FSS)

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(*Continued from page 130*)

E. H. Sargent & Co., Chicago, Ill.—Manufacturer and distributor of scientific laboratory instruments, apparatus, supplies, and chemicals has started construction of a new plant in Springfield, N. J., to house its eastern division. This was announced recently by T. M. Mints, president of the 106-year old Chicago firm.

Weksler Instruments Corp., Freeport, L. I., N. Y.—The name Weksler Thermometer Corp. has been changed officially to Weksler Instruments Corp., effective January, 1958. The change was announced by Edward P. Dobrin, president of the Freeport, N. Y., firm. In disclosing the name change, Mr. Dobrin pointed to the fact that in recent years his company's products have become so diversified and of such wide range as to make the change in name imperative.

NEWS OF LABORATORIES

Haller Testing Labs., Inc., New York, N. Y.—Raymond A. Ayres has been appointed vice-president of the Haller Testing Labs., Inc., it has been announced by Elliot A. Haller, president. Mr. Ayres has been manager of the Plainfield, N. J., division since 1955.

Law Engineering Testing Co., Atlanta, Ga.—Law Engineering Testing Co. is the new name of Law-Barrow-Agee Laboratories, Inc., one of the South's pioneer firms in the testing field. Announcing the name change, the company reported also that Thomas C. Law, widely known in professional circles for a half century, is vacating the presidency, to be succeeded by George H. Nelson, vice-president since the company's founding in 1948.

OTHER SOCIETIES' EVENTS

April 23—**The Textile Institute,** Annual General Meeting, Nottingham, England

April 27–30—**Chamber of Commerce of the United States,** 46th Annual Meeting, Washington, D. C.

April 27–May 1—**American Ceramic Society,** 60th Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 28–May 1—**6th Annual Semiconductor Symposium, Electrochemical Society,** Statler Hotel, New York, N. Y.

April 30–May 1—**The Fiber Society,** Spring Meeting, The Clemson House, Clemson, S. C.

May 1–8—**American Society of Tool Engineers,** Tool Show, Convention Center, Philadelphia, Pa.

May 4–7—**National Instrumentation Flight Test Symposium, Instrument Society of America,** Park-Sheraton Hotel, New York, N. Y.

May 4–7—**Air Conditioning and Refrigeration Institute,** Annual Meeting, The Homestead, Hot Springs, Va.

May 5–7—**American Mining Congress,** Coal Convention, Netherland-Hilton Hotel, Cincinnati, Ohio.

May 6–9—**Acoustical Society of America,** Spring Meeting, Hotel Shoreham, Washington, D. C.

May 12–14—**Council of Engineering Societies Secretaries,** Annual Meeting, The Cleveland Hotel, Cleveland, Ohio.

May 12–15—**American Petroleum Institute,** Division of Refining, Hotel Statler, Los Angeles, Calif.

May 12–15—**Building Officials Conf. of America,** 43rd Annual Conference, Atlantic City, N. J.

May 12–16—**Southwestern Metal Exposition & Congress, American Society for Metals,** State Fair Park, Dallas, Tex.

May 13–14—**Porcelain Enamel Institute,** Mid-year Divisional Conference, Edgewater Beach Hotel, Chicago, Ill.

May 14–16—**Society for Experimental Stress Analysis,** Spring Meeting, Hotel Manger, Cleveland, Ohio.

May 19–22—**American Electroplaters Society,** Annual Meeting, Cincinnati, Ohio.

May 19–23—**American Foundrymen's Society,** Foundry Show & 62nd Castings Congress, Public Auditorium Cleveland, Ohio.

May 19–23—**American Welding Society,** Spring Technical, National & Welding Show, Hotel Schroeder, Milwaukee, Wis.

May 19–23—**National Fire Protection Assn.,** Annual Meeting, Palmer House, Chicago, Ill.

May 20–21—**Society of American Military Engineers,** Annual Meeting, Mayflower Hotel, Washington 25, D. C.

May 21–23—**Engineering Institute of Canada** Annual Meeting, Quebec, Canada.

May 25–28—**American Leather Chemists Assn.,** Annual Meeting, New Ocean House, Swampscott, Mass.

May 25–29—**Air Pollution Control Assn.,** Annual Meeting, Sheraton-Hotel, Philadelphia, Pa.

May 26–28—**American Society for Quality Control,** National Convention, Hotel Statler, Boston, Mass.

May 26–28—**Chemical Institute of Canada,** 41st Annual Conference and Exhibition, Royal York Hotel, Toronto, Canada.

Summer Career Program Aids in Scientist Recruiting

A PROGRAM which gives students an opportunity to become acquainted with a Government research laboratory during their summer vacation periods is helping the National Bureau of Standards to meet its increasing demand for high-caliber technical graduates. 174 of 1957's record enrollment are maintaining NBS affiliation: of the 236 students employed at the Washington laboratories in the past summer, 44 are still on full- or part-time duty and 130 who plan to return to the Bureau have been granted leave without pay to continue their education. One-half of the 208 students employed in 1956 were included in last summer's program. Another 57 had remained on duty permanently. The program, inaugurated in 1948, was extended to the NBS laboratories in Boulder, Colo., in 1956, where it has already resulted in a number of permanent appointments.

Besides being successful as a long-range recruitment plan, the Student Trainee Program demonstrates the ability of younger employees to make direct contributions to the research program. For example, written evaluations by supervisors at the Washington laboratories showed that almost 85 per cent of the 1956 trainees did above average work. Outstanding work was performed by several students.

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- Additional accessories, available at extra cost include: Polaroid Land Camera attachment for "60-second" photography; 35mm camera attachment; low power (5–40X) objectives; vacuum heating stage for temperatures to 1100°C.

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- Standard optics include 4 parfocal objective lenses: 5X, 10X, 40X, 100X oil immersion on revolving nosepiece; 3 eyepieces: P5X, Micrometer 10X, Ke15X, all coated. Magnification range 25–1500X.
- Vertical illuminator with iris diaphragm. Transformer housed in microscope base. A microswitch on the base provides an extra high intensity for photography.
- Binocular model has provision for attaching 35mm camera to microscope base. A 35mm camera attachment is available to attach to the eyepiece tube of the monocular model.
- Calibrated square mechanical stage with calibrated rotatable stage plate.
- Calibrated polarizing apparatus, 5 filters, dustcover, cabinet, etc. all included.
- Additional accessories available at extra cost include: 35mm camera attachment; K20X eyepiece for 2000X; transmitted-light accessories for transparent specimens; vacuum heating stage.

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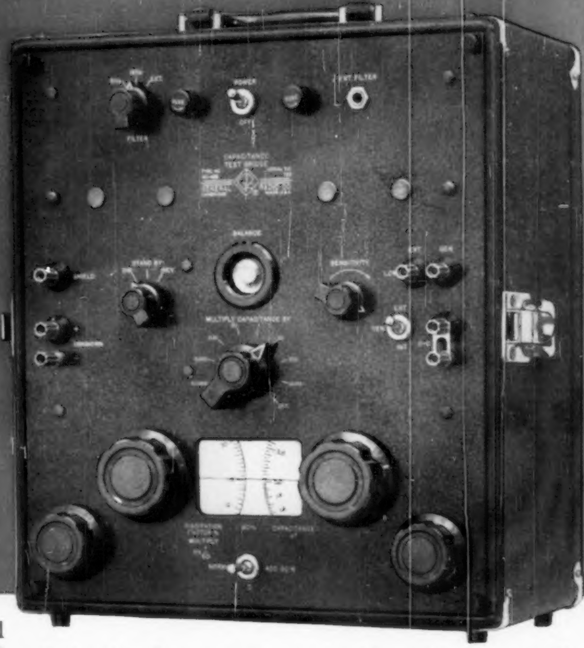

The GR® Type 1611-B Capacitance Test Bridge will measure all kinds of capacitors, particularly polarized electrolytic types, at 60 and 120 cycles in accordance with current EIA standards. Other features include wide 10 billion-to-one range for capacitance measurement, built-in visual null indicator, provision for external polarizing voltages, shielded construction for use in moderate electrostatic fields, luggage-type carrying case, and provision for three-terminal or guarded measurements.

This Bridge also fills the need in the electric-power industry for a general-purpose capacitance bridge for dissipation-factor tests on bushings, insulators, lineman's gloves, splicing tapes, and other dielectric materials. Insulation tests on transformers, cables and rotating machinery can also be performed conveniently. Cable manufacturers and users will find the Bridge well suited for locating faults and for testing cable dissipation factor and capacitance.

Type 1611-B Capacitance Test Bridge used with the Type 1214-AS2 120-Cycle Oscillator ($100) to measure electrolytic capacitors. Type 1204-B Unit Variable Power Supply ($100) supplies necessary d-c polarizing voltage.

SPECIFICATIONS

Capacitance Range: 0 to 11,000 μf at 60 cycles. 1 μf to 11,000 μf at 120 cycles or other external frequency.

Dissipation-Factor Range: 0 to 60% at 60 cycles. Range proportional to frequency (0 to 120% at 120 cycles).

Accuracy: Capacitance $\pm 1\%$. Dissipation factor $\pm\left(2\% \text{ of dial reading } + 0.05\% \times \frac{f}{60}\right)$.

Sensitivity: Sensitivity is such that any capacitance in the range 100 $\mu\mu$f to 10,000 μf can be balanced to a precision of at least 0.1%.

A-C Voltage Applied to Capacitance under Test: Maximum of approximately 125 volts at 100 $\mu\mu$f to less than 3 volts at 10,000 μf.

Detector Filter: Tuned to 60 or 120 cycles, selected by switch. Jack provided for external filter at other frequencies.

Signal Source: Built-in 60-cycle source. Type 1214-AS2 Oscillator is recommended for 120-cycle measurements.

External Fields: Portable, luggage-type carrying case is completely shielded to insure freedom from electrostatic pickup. Fields usually encountered in shop and laboratory, up to several thousand volts, will not affect the accuracy.

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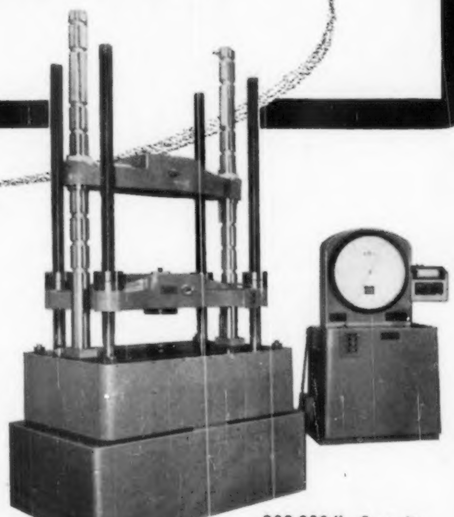

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